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# ***JPRS Report***

# **Science & Technology**

## ***USSR: Electronics & Electrical Engineering***

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# Science & Technology

## USSR: Electronics & Electrical Engineering

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**KFT-1 Photoelectric Television Colorimeter-Luminance Meter**

927K0027A Moscow SVETOTEKHNIKA in Russian  
No 7, Jul 91 pp 1-2

[Article by I. A. Dubovik, I. V. Petrochenko, N. B. Shimbirev, All-Union Optical-Physical Measurements Institute, Moscow]

UDC 535.65:338.984.2

[Abstract] The development of a new KFT-1 colorimeter/luminance meter with a chromaticity coordinate measurement accuracy of  $\pm 5 \times 10^{-3}$  and a luminance measurement accuracy of  $\pm 10$  percent which makes it possible to take measurements with two replaceable entrance diaphragms with 50 and 20 mm diameters is reported. It was developed by the All-Union Optical-Physical Measurements Institute together with the Moscow Television Research Institute pursuant to the testing procedure formulated in GOST 8.205—90. The KFT-1 device is executed as two units - a remote colorimeter head and an electronic unit. The instrument is intended for quality control of color picture tubes and is developed on the basis of the Laviniya picture tube characterized by a good long-term stability which makes it possible to calibrate TV picture tubes by the three primary color reference stimuli (R, G, B) on the basis of the  $D_{65}$  source. Figures 2; references 4.

**Automobile Headlight Efficiency**

927K0027B Moscow SVETOTEKHNIKA in Russian  
No 7, Jul 91 pp 3-7

[Article by K.M. Levitin, U.A. Eshankulov, Scientific Research Institute of Automotive Electronics]

UDC 621.32:629.113.06

[Abstract] Headlights with standardized European light distribution and either conventional or halogen incandescent lamps and their correspondence to international and domestic light distribution standards (GOST 3544—75) which define illuminance standards at control zones and special screen points are addressed. Attempts to establish and quantify the principal factors affecting the visibility range of road objects under the conditions approximating real operation to the utmost are described. The analysis was based on the results of road tests studying the visibility range of a dummy pedestrian and a shield simulating road obstacles; a total of about 800 measurements was taken. Round commercially made FG-140 headlights with a 170 mm diameter and conventional A12-45+40 incandescent lamps (LN) fully meeting European standards for the VAZ 21013 passenger car were used in the tests. The studies made it possible to ascertain the principal factors affecting the headlight operating efficiency: the phase control parameter, road object reflectance, position of road objects on the roadway, and vehicle speed. Experimental data processing

resulted in empirical data which make it possible to compute the visibility range of road entities within a 10 percent error depending on the above parameters. It is shown that the results of the experimental studies may be used to estimating the automobile headlight efficiency in order to improve the traffic safety at night as well as for forensic and investigative purposes. Figures 4; tables 3.

**On Need for Emergency and Evacuation Lighting**

927K0027C Moscow SVETOTEKHNIKA in Russian  
No 7, Jul 91 pp 10-11

[Article by B. Hurst, Lighting Engineering Enterprise Federation, Great Britain]

UDC 628.978.6

[Abstract] A report delivered by the author to the Symposium on Standby Lighting held in Brussels on 30 October 1990 is adapted and translated from the English by V.N. Stepanov. The need to develop safe evacuation guidelines in Common Market countries and illustrate it using the examples of disasters where emergency evacuation measured had not been taken, resulting in a loss of life, is identified; it is noted that state legislations are often inadequate or inaccessible. The conclusion is drawn that a unified legislation must be passed in various countries and must be easily accessible and written in plain language. In this respect, the European Commission is commended for its work to develop guidelines for building safety as well as health and work safety. The need for a comprehensive safe evacuation legislation is recognized. The editors of *Svetotekhnika* wish to focus the lighting engineers' and experts' attention on this important issue which remains quite urgent in the USSR. References 1.

**On Designing Electric Lighting and Power Plants in Clinics**

927K0027D Moscow SVETOTEKHNIKA in Russian  
No 7, Jul 91 pp 25-27

[Article by R. I. Pashkovskiy, Leningrad Building Committee]

UDC 628.931:628.973

[Abstract] The rules and standards which govern the design of electric lighting and power plants in clinics (LPU) are addressed and individual issues of clinic design are considered; to this end, recommendations are given so as to avoid contradictions between building standards VSN 59—88 coordinated with the USSR Public Health Ministry and Methodological Guidelines for Determining Design Electric Loads in Public Health Enterprises approved by the USSR Public Health and Urban Development Ministries. It is noted that such problems as setting up commercial production of NBL02, LBO08, and DS-19 lighting fixtures, improving the quality of NBL02 lighting fixtures, and developing a new bedside light in order to replace the

NBL02 remain unsolved. The need for new designs of connector plugs and consoles of bedside lighting fixtures on the basis of existing aluminum sections is identified. Tables 1; references 8.

### KZF11 Optical Sound Recording Equipment System

927K0025A Moscow *TEKHNICA KINO I*  
*TELEVIDENIYA* in Russian No 6, Jun 91 pp 16-18

[Article by V. I. Glazunova, V. N. Nikiforov, Central Design Office of the Ekran Scientific Production Association]

UDC 778.534.427

[Abstract] The KZF11 optical sound recording equipment system which makes it possible to record the negatives and positives of double-track monaural and two-channel, single-track sound recordings on 35 mm movie film is described. The system is characterized in that it is possible to record sound in a wide frequency range while the sound track's amplitude-frequency response is linear within a 20-20,000 Hz band and is flat within  $\pm 0.5$  dB. The block diagram of the system and its operating principle are described in detail. The system makes it possible to switch from one type of sound track recording to the other and back without additional adjustments; it is expedient to use the KZF11 for recording hi-fi sound tracks by the direct positive technology. The use of optoelectronic facilities also makes it possible to produce optical sound tracks comparable to magnetic tapes in fidelity. The KZF11 system has been adopted by a departmental committee and recommended for use in movie studios. Figures 3.

### Subscriber Needs Vs. Investment Priorities: TV or Telecommunications?

927K0025B Moscow *TEKHNICA KINO I*  
*TELEVIDENIYA* in Russian No 6, Jun 91 pp 27-35

[Article by A. P. Altayskiy]

UDC 654.197:658.152

[Abstract] The new economic reality developing in the field of cable and broadcast TV due to a partial privatization of the latter and the increasingly stringent requirements being imposed on the former is discussed. The range of peripheral products - attachment to commercial television (TV) sets enabling them to receive cable programs, 93 in all - is summarized and the possibility of setting up telecommunication networks proper, e.g., ARCNET, ETHERNET, etc., is considered. Organization of a network which in addition to TV programs, provides data services is illustrated using the example of the AEG-KABEL firm and its block-diagram is presented. Examples of commercial services set up on the basis of microcomputers (PEVM) in the field of motion pictures and TV, such as information retrieval systems,

executive search services, and disable status monitoring system whereby all disabled people in town are automatically called up each morning and alarm is issued to the police department if no answer is received, are cited. The author's work on a Who's Who reference is described. The need to form a union involving all experts in the field so as to coordinate their activity is identified. Figures 2; tables 1.

### Cable TV: Ends and Means, Part 2.

927K0025C Moscow *TEKHNICA KINO I*  
*TELEVIDENIYA* in Russian No 6, Jun 91 pp 39-43

[Article by A. Barsukov]

UDC 621.397.743

[Abstract] The concept of intellectual property and honoraria for works of art as well as the discrepancy between income levels of top artists and people at the bottom of the pay scale, i.e., the decile wage differentiation factor, in countries with different socioeconomic systems are discussed with respect to the benefits enjoyed by cable television producers, actors, etc., in the USSR. The need for, and potential impact of, legislation governing these issues in the individual republics are analyzed. Examples of economic regulations ensuring the survival of various media abroad, e.g., the need to prevent monopolization, are cited. Criteria used in other countries by courts to determine violations of antitrust laws are summarized and the aims of such laws are explained. The role of cable TV as a means for democratizing modern society and reducing social tension is discussed.

### Natural and Artificial Lighting. Building Codes and Regulations SNiP II-4-79 (as Amended).

#### General Principles

927K0042A Moscow *SVETOTEKHNICA* in Russian  
No 6, Jun 91 pp 1-31

[Article by Editors of *Svetotekhnika*. The text of the "Artificial and Natural Lighting" section of Building Codes and Regulations SNiP II-4-79, as amended, is reprinted in full in response to numerous requests.]

[Abstract] The general principles stipulate the cases where the codes and regulations herein must be adhered to as well as the cases where builders are exempt from them. For the purpose of visual activity, all rooms are divided into four categories: rooms in which the objects of visual activity are being identified at a fixed workers' line-of-sight direction toward the working surface; rooms in which objects are viewed at an arbitrary line-of-sight direction and the ambient space is viewed; rooms in which the ambient space is viewed with an extremely brief and sporadic identification of objects; and rooms in which general orientation in the interior space occurs. Standardized values of the illuminance and daylight factor (KYeO) for natural and combined illumination

and on the working surface are summarized and the safety factor is formulated for all combinations of natural and artificial lighting. Standards of ultraviolet radiation are established. Tables 3.

### Urban and Rural Outdoor Lighting

[Abstract] The standards of outdoor lighting in towns, villages, and rural residential areas are established for different climatic building zones, such as the Northern Asian Region and the Northern European Region to the north of 66°N, and stipulate the illuminance levels for the roadways, sidewalks, shoulders, and overpasses and underpasses. The ratios of the maximum/minimum roadway pavement luminance are established for different conditions and the mean horizontal illuminance of various types of outdoor areas is specified. Illumination of driveways to fire hydrants is stipulated. Provisions are made for increasing the illuminance standards in the capitals of union republics, war-hero cities, resort areas, and major ports. No more than a half of lighting fixtures may be turned off at night at a standard mean illuminance of 0.4 nits while no fixture may be turned off at a 0.2 nit mean standard level or in fire lanes and special areas. Standards for lighting fixtures and their suspension height in streets, on bridges, in tunnels, pedestrian underpasses, and other areas are established. Tables 5.

### Natural Lighting Design

Formulae for designing natural lighting and calculating the fenestration area are cited for lateral and overhead lighting. The light characteristic and shadow factor which takes into account the window light blockage by other buildings are specified and the general translucence and its components are defined for various types of glass and other materials. Methods of calculating the daylight factor (KYeO) in the case of lateral and overhead lighting and their combinations are described. Sunlight protection properties of various devices, such as awnings, louvers, blinds, and screens, are summarized. Graphic methods of computing the geometrical daylight ratios for various types of lighting using A.M. Danilyuk's technique are presented. The values of light characteristic of rectangular, trapeze, and saw-tooth shaped skylights and various fenestration shapes are summarized. Figures 8; tables 11.

### Recommended Color Characteristics of Artificial Light Sources

The recommended color characteristics of artificial light sources are stipulated for various types of visual activity involving different color discrimination requirements, e.g., quality control of ready products, sewing, painting, and other manual operations, assembly, handling of achromatic products, and general perception of the interior at several illuminance levels, in candelas: 500 and over; 300 and over; 300-500; 150-300; and under 150. The minimum color-rendering indices of light sources in industrial and public buildings, color temperature ranges in industrial and public buildings, and examples of light source types in industrial and public buildings are summarized. Tables 1.

### Measures to Limit Reflected Glare of Surface With Specular and Mixed Reflectance

The measures necessary for limiting the reflected glare of surfaces with specular and mixed reflectance for performing categories I-IV operations are summarized. For this purpose, manual work is classified into the handling of metal and plastic opaque surfaces; handling of dark plastic, ceramic, and other surfaces; work which calls for discriminating diffuse-reflecting objects against a diffuse background through a translucent material layer; and operations of recognition and work with surfaces with a mixed reflectance. Various types of light sources in the lighting fixtures and their parameters, position relative to the work place surface, and the perceived ratio of object/background luminance discrimination are described. Figures 2; tables 3.

### Founding Conference of Russia's Scientific-Technical Power and Electrical Engineers Society

927K0042F Moscow SVETOTEKHNIKA in Russian  
No 6, Jun 91 pp 31-32

[Article by L. M. Krasovitskaya, RNTOE Directorate]

UDC 628.9.061.22

[Abstract] The founding conference of Russia's Scientific-Technical Power and Electrical Engineers Society (RNTOE) was held in April 1991 in Vladimir. Several stages of preparations for the conference included three plenary sessions of the All-Union Scientific-Technical Power and Electrical Engineers Society's (VNTOE) board of directors (TsP) held in 1989-1990 which examined the goals and purposes of creating a republican society board and searching for ways of improving VNTOE operations in Russia. Corresponding Member of the USSR Academy of Sciences Yuriy Sergeyevich Vasilyev addressed the founding conference and justified the need for setting up RNTOE. Draft bylaws and other documents were submitted to the conference for consideration and/or approval. Mr. Yu.S. Vasilyev was elected president of RNTOE while V.I. Bryzgalov, V.V. Yershevich, S.A. Kazarov, and N.I. Suvorov were elected vice presidents. Lidiya Matveyevna Krasovitskaya was elected executive director of RNTOE board and Olga Nikolayevna Dobrinskaya - chairman of RNTOE auditing commission. Out of the RNTOE 228 representative in Russia, 155 participated in the founding conference. The society is headquartered in Leningrad.

### 'Every Reason to Believe....'

927K0008A Moscow RADIO in Russian No 6, Jun 91 pp 7-8

[Article by S. Smirnova, V. Afanasyev, Moscow]

[Abstract] The use of electronic customs inspection tools - X-ray units, metal detectors, diathermal testers, and other instruments - and the resulting improvements in



contraband detection are described. The use of photodetectors in order to protect customs inspectors from harmful radiation is considered. Special attention is focused on diathermal testers which make it possible to distinguish costume jewelry from real diamonds. It is emphasized that of the entire range of detection tools, only the metal detectors are domestically made. The rest of this equipment is supplied by U.S., German, British, and other foreign companies at a considerable cost in foreign exchange. The need for special staff training for using expensive imported detection gear is identified and measures to develop and manufacture domestic customs inspection equipment are outlined. The decision to join the International Customs Union is reported and the involvement of Soviet defense enterprises in manufacturing detection tools under the conversion program is commended. The authors are grateful to the staff of the Main Directorate of the State Customs Inspection Administration and customs workers at the Sheremetyevo-2 airport. Figures 1.

#### Facsimile Communications

927K0008B Moscow RADIO in Russian No 6,  
Jun 91 pp 9-12

[Article by G. Ivanov, Moscow]

[Abstract] The need to transmit images over telephone channels and the advances in today's electronics which made such tasks possible, namely the methods of facsimile (*facio similis* in latin) transmission, are outlined. The general principles of static graphic image transmission over telephone channels, i.e., the sequence of reading the original, producing a digitized image, encoding it, modulating, transmitting, and demodulating the signal, decoding the image, producing a digitized image on the receiving side, and printing out a copy of the original is described. The block diagram of a fax machine is presented and CCITT (MKKTT) transmission protocols are cited. The use of laser fax machines and their high resolution are mentioned and the operating principles of electronic mail are described. Figures 4; tables 1; references 2.

#### World Radio Broadcasting Structure

927K0008C Moscow RADIO in Russian No 6,  
Jun 91 pp 14-17

[Article by A. Barbanskiy]

[Abstract] The development of radio broadcasting in the USSR and abroad since 1922 is outlined and the radio frequency band regulation and allocation in the framework of the International Telecommunications Union (MSE) and its consultative bodies - the CCITT (MKKTT) and IFRB (MKRCh) - is described. The role of WARC (VAKR) and RARC (RAKR) in making decisions and producing various rules for approval by the international telecommunications convention adopted in 1982 is explained. The international division of broadcast frequencies in three regions of the

world into the long, medium, short, and UHF-VHF bands is summarized. Various broadcast signal specifications, e.g., the minimum level of legitimate signal (60 dB/μV/m), permissible signal/noise ratio in the composite and adjacent channels (30 and 9 dB), and the carrier spacing (9 kHz in Europe since 1978), as well as measures to reduce the size of interference zones resulting from operation on the same frequency are described. Old and new frequency plans adopted for various broadcast bands are presented and ways of utilizing multihop propagation for beaming broadcasts at specific areas are described. The procedure for updating frequency schedules four times a year (once for each season) is cited and plans to switch to single sideband (OBP) broadcasting by 2015 as well as using the partially suppressed carrier method during the transition period are mentioned. Figures 1; tables 1.

#### Pollution by... Sound

927K0008D Moscow RADIO in Russian No 6,  
Jun 91 pp 18-19

[Article by A. Tereshchenko]

[Abstract] The negative impact of acoustic (noise) emission on humans is illustrated using the examples of large outdoor concerts where the sound level may reach 150,000 W and drown out the roar of jet planes taking off nearby and portable players with ear bud speakers which create a sound level of 115-120 dB and may lead to permanent hearing loss. Various neurological disorders which result from exposure to loud sound with deliberate phase distortions, i.e., accentuated bass line, are described. The effect of various types of music on labor productivity - both negative and positive - is discussed. New recommendations contained in GOST 12.1.003—83 and the rules and regulations governing consumer electronics contained in GOST 12.4.026—76, 12.4.051—87, and 12.1.001—89 are outlined. The role of sound in the total ecological balance and its effect on man are discussed.

#### Packet Communication Modem

927K0008E Moscow RADIO in Russian No 6,  
Jun 91 pp 23-25

[Article by V. Golutvin (UB5WPR), G. Chliants (UY5XE), Lvov]

[Abstract] The concept of packet communication where amateur radio (ham) operators are linked by computers into a network using ether as the medium is summarized and the features which distinguish packet switching networks from channel switching and other networks are presented. The role of terminal node controllers (TNC), an interface linking together ham computers is outlined. A primary packet communication device - a double-speed modem - which makes it possible to operate in a network at 300 and 1,200 baud information interchange rates in the short and ultrashort wave bands, respectively, is described. The modem can be connected to any

microcomputer with proper packet communication software, including the Radio-86RK. Block-diagrams of the demodulator and modulator are presented and their components and operating principles are described in detail. The modulator, demodulator, and voltage-controlled oscillator are executed on DA series chips and the digital-to-analog converter is designed on the basis of a DD3 chip functioning as a ring shift register. Figures 2.

#### Orion-128: Screen Memory Management

927K0008F Moscow RADIO in Russian No 6,  
Jun 91 pp 36-39

[Article by V. Sugonyako, V. Safronov, Moscow oblast]

[Abstract] The design features of the Orion-128 ham microcomputer (PRK) and particularly its video RAM (OZU) are described. The structure of the 12 K video RAM and the specific function of all address registers are illustrated and described. The memory cell distribution in the screen space, i.e., the screen area addressing system, consisting of 48 vertical column with 256 cells in each is schematically shown and the specific features of using programs which make it possible to utilize four screen windows in color are outlined. Three display modes - monochromatic, four-color, and sixteen-color - and the instructions for switching from one mode to another are explained. Routines for directly recording values in individual video RAM cells are described in detail. Figures 5; tables 1.

#### Where are Television Coverage Boundaries?

927K0008G Moscow RADIO in Russian No 6,  
Jun 91 pp 41-43

[Article by A. Shur, Moscow]

[Abstract] Consistent coverage is defined as reception of a stable TV image, especially in color, during at least 330 days of the year. The factors affecting the transmitting television (TV) station coverage zone which varies in time, particularly the dielectric permittivity of the air, are described. The latter factor, in turn, depends on the humidity, temperature, and pressure or, in other words, the weather. A method of calculating the line-of-sight TV reception range, allowing for refraction fluctuation, is presented and the dependence of the consistent reception zone radius on the TV signal frequency is illustrated by examples of the minimum field strength necessary for secure reception in the meter and decimeter bands: at least 300-700  $\mu\text{V/m}$  or 50-57 dB for channels 1-12 in the meter band and 3,200  $\mu\text{V/m}$  or 70 dB for channels 21 and higher. Calculations of the coverage zone boundary for flat regions and mountainous terrain are illustrated using the examples of Sochi and Moscow TV stations; for this purpose, the coverage boundary is defined not as the boundary of the line-of-sight zone but the line at which the field strength decreases to the minimum acceptable level. It is shown that in the decimeter band, e.g., channel 33, the line-of-sight range considerably exceeds the coverage radius: given a 530 m high transmitting antenna,

the minimum field strength for secure reception is 70 dB, i.e., at a 64 km distance while the line-of-sight range of such an antenna is 108 km. Figures 5.

#### Series KR1561 Chip Applications

927K0008H Moscow RADIO in Russian No 6,  
Jun 91 pp 57-60

[Article by S. Alekseyev, Moscow]

[Abstract] The CMOS (KMOP) KR1561 chip - a successor to the K176 and K561 chips - which consume fractions of a microampere in static operation and are characterized by buffer elements on the input and output regardless of complexity and their design features are summarized. The operation of certain series KR1561 chips, especially that distinguishing them found the K176 and K561, is described in detail. They can be used as univibrators, decoders, various types of counters, registers, multiplexers, NAND, NOR, exclusive OR, and AND gates, CMOS-TTL converters, JK flip-flops, and Schmitt flip-flops. Specific chip configurations and features of all of the above applications and the number of terminals are described. KR1561 chips are encased in a plastic housing and have 14 or 16 terminals. Their dimensions are similar to those of the K176 and K561 chips. Figures 7; tables 1; references 2.

#### Miniature Tape Player Circuitry

927K0008I Moscow RADIO in Russian No 6,  
Jun 91 pp 66-72

[Article by V. Shachnev, Zelenograd]

[Abstract] The most popular electric circuits of various functional units of miniature tape recorders/players, both using chips and transistors, are analyzed. Since the right and left channels of miniature stereo tape players are identical, the operation of only one channel is considered. The circuit design of tape players with playback only and read-record heads are described. Tape recorder switching from playback to recording and the operation of the erase head and recording amplifier channel are considered. The circuit design of the playback amplifier is cited and the purpose of its elements is described. The operation of an automatic recording gain control system and its design and the design of a transistor recording amplifier are described. The operating principle of the autostop device which disconnects the entire electric circuit from the power supply when the tape runs out and the operation of the pause key are described. The design and operating principle of the transistor-based governor, speech amplifier, and biasing current generator are described. It is indicated that in general, the circuit design of miniature tape recorders/players depends on the availability of component base and the overall dimensions of the unit being designed. Figures 11; references 4.

**Software Package for Predicting Ultrashort Radio Wave Propagation Conditions Over Sea**

927K0012A Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNIKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1315-1319

[Article by M. V. Belobrova, V. K. Ivanov, A. V. Kuku-  
shkin, M. B. Levin, Ya. A. Fastovskiy, Radioastronomy  
Institute at the Ukrainian Academy of Sciences]

UDC 621.371:551.510

[Abstract] A software system (PS) for predicting radio wave propagation conditions in the boundary atmosphere layer (APS) is described; it represents a software package which realizes the physical mechanisms of this phenomenon developed to date and differs from the radiophysical part of the IREPS system (USA) in that it partially takes into account the mechanism of wave scattering by turbulent tropospheric refractive index fluctuations. The following five mechanisms of electromagnetic wave propagation mechanisms in the boundary atmosphere layer are analyzed: evaporation ducting allowing for scattering by turbulent atmospheric refractive index fluctuations; propagation in the tropospheric duct formed by an elevated refractive index inversion; classical simple scattering mechanism (long-range troposcatter (DTR)) in the upper atmospheric layers; diffraction field contribution taken into account in Born's approximation; and reflective formulae obtained by Feynman's integrals method for trajectories which take into account scattering by turbulent tropospheric refractive index fluctuations for the illuminated region. The software organization is described. References 13: 10 Russian, 3 Western.

**Noncoherent Electromagnetic Wave Scattering by Weakly Ionized Plasma Layer**

927K0012B Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNIKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1327-1341

[Article by A. G. Zagorodniy, A. S. Usenko, Theoretical  
Physics Institute at the Ukrainian Academy of Sciences]

UDC 533.932

[Abstract] Noncoherent electromagnetic wave scattering by plasma - one of the best methods of plasma diagnostics - is considered. Electromagnetic fields scattered by electron density fluctuations in a weakly ionized plasma layer are analyzed and the differential noncoherent electromagnetic wave reflection and transmission factors are calculated. In addition, the dynamic form-factor of the plasma layer at arbitrary values of the particle absorption by boundary planes are analyzed in the case of a small frequency variation due to scattering which corresponds to a diffusion approximation of computations of

electron density fluctuation correlation functions. Data on a numerical analysis of general correlations of angular and spectral distributions of the scattered radiation intensity for various values of particle absorption by the boundaries, plasma parameters, and ambient medium are presented. References 23: 18 Russian, 5 Western.

**Phase Conjugation Quality in Systems With Partially Filled Aperture**

927K0012C Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNIKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1412-1416

[Article by V. Ye. Kirakosyants, V. A. Loginov, V. V. Slonov, Astrofizika Scientific Production Association]

UDC 621.373.826

[Abstract] The use of focusing systems with a "distributed" structure is addressed; in particular, a multichannel system with partially filled aperture where the distance between individual subapertures may considerably exceed the subaperture dimension is considered. Phase conjugation (OVF) is performed in each channel in order to compensate for the distortions contributed to the radiated signal by a turbulent propagation medium. It is assumed that the phase conjugation algorithm is realized with the help of an oscillator system. The phase conjugation quality is estimated as a function of the total number of algorithm channels, signal/noise ratio, turbulence intensity along the path of propagation, and the degree of master laser (ZG) radiation coherence. The resulting expressions make it possible to estimate the delay equalization accuracy of the channels as a function of the above parameters. References 3: 2 Russian, 1 Western.

**Spatial Variations of Sea Clutter Strength Under Superrefraction Conditions**

927K0012D Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNIKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1423-1424

[Article by A. V. Volkov, K. V. Latyshev, A. V. Koshel,  
L. A. Slavutskiy, B. M. Shevtsov, A. A. Shishkarev,  
Pacific Oceanology Institute at the Far Eastern Branch of  
the USSR Academy of Sciences]

UDC 537.029.62:551.501.81

[Abstract] The use of spectral characteristics of agitated sea returns for evaluating the sea surface condition is discussed. The results of radio physical research which made it possible to obtain data on spatial variations of radar return strength in the presence of a near-surface evaporation duct are presented. An Okean M-03 all-round looking radar installed on board a research vessel was used; in addition, contact measurements of the refractive index profile in the near-surface atmospheric layer were taken by a probe. The spatial behavior of the

strength of returns with changes in the refractive index profile is established. The consistency of analytical and experimental data for two wavelengths (3 and 10 cm) makes it possible to conclude that refraction significantly affects the clutter strength in the over-the-horizon region, especially on the 3 cm wavelength while small-scale beats are due to the wave parameters. Thus, the radar measurement technique makes it possible to use simple facilities in real time for estimating the attenuation function and, likewise, radio wave propagation in the near-water atmospheric layer. Figures 2; references 7: 5 Russian, 2 Western.

#### **Excitation of Inhomogeneities During Ionosphere Heating by Transmission of Powerful Radio Waves**

927K0012E Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1424-1425

[Article by N. V. Bakhmetyeva, Yu. A. Ignatyev, P. B. Shavin, Radiophysics Science Research Institute]

UDC 551.510.535

[Abstract] Experimental investigations of the interaction of powerful decameter radiation with the F-layer ionospheric plasma carried out during summer nights are reported; the ionosphere was heated by a Sura unit with a maximum equivalent output of 50-70 MW which radiated upward in the 4.785-9.05 MHz band in four-minute long cycles with a subsequent six-minute pause. To diagnose artificial ionospheric electron concentration inhomogeneities excited by powerful radiation, a unit located 100 km to the west of the Sura unit was used. A test wave transmitter emitted pulsed signals lasting 25  $\mu$ s with a 50 Hz repetition rate at a 2.95 MHz frequency; test waves were radiated and received by antenna systems with a 100° beamwidth at half-power level. Stable backscattering signals (SOR) from the artificially excited area were observed in the experiments and examined. The time progress of backscattering signal amplitudes was plotted at three different frequencies. The results make it possible to attribute the backscattering signal formation in a short path to the use of low test frequencies and to the generation of artificial ionospheric inhomogeneities by the self-focused thermal instability. Figures 1; references 7.

#### **Two-Frequency Microwave Gunn Diode Amplifier Operation**

927K0012F Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1429-1430

[Article by D. A. Usanov, S. S. Gorbatoev, A. A. Semenov, Saratov State University]

UDC 621.375.6

[Abstract] The results of an experimental investigation of the output signal spectrum of a Gunn diode microwave (SVCh) amplifier in the case where an additional microwave signal is applied to the diode together with the main signal are cited. A waveguide amplifier design was used in the experiment. At input signals under 8 mW, an amplified signal of the same frequency was observed on the amplifier output while subharmonic components and their combinations were observed on the amplifier output when the input signal strength exceeded 8 mW. The appearance of these components is explained by solving the differential equation of the oscillatory circuit with a Gunn diode whose capacitance depends on the microwave signal amplitude. The amplifier output signal spectrum and the dependence of the input power threshold of the main signal at which the f/4 subharmonic appears, with and without the additional microwave signal, on frequency within the amplification band are illustrated. The results show that the effect of the additional signal may decrease the main signal power threshold at which subharmonic components appears by more than one and a half times. The measurement results also indicate that the additional signal increases the subharmonic component amplitudes; this is illustrated by the dependence of the ratio of the f/4 subharmonic amplitude with an additional microwave signal to the same amplitude without it. It is shown that the above patterns may be useful in operating microwave Gunn diode amplifiers. Figures 3; references 2.

#### **Experimental Simulation of EHF Band Waveguide Ferrite X-Circulators**

927K0012G Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1430-1431

[Article by R. I. Andreyeva, V. A. Neganov, T. A. Chasovnikova, A. G. Glushchenko, Kuybyshev Telecommunications Institute]

UDC 621.372.853.2

[Abstract] The relative advantages of X-circulators over Y-circulators are discussed and the experimental results of simulating new EHF (KVCh) band X-circulators using a rectangular ferrite parallelepiped as a resonator and a complex oscillatory system consisting of a combination of ferrite cylinders are reported. An H-plane four-port (X) circulator with a cylindrical ferrite resonator is examined and experimental dispersion curves of an X-circulator with a capacitive rod as well as the frequency response of an X-circulator with an inductive metal rod are presented and the characteristics of both circulators are compared showing that the adjacent arm isolation frequency band is greater in the inductive circulator than in the capacitive one (5 percent vs. 2.5 percent). X-circulators with a rectangular parallelepiped resonator and an oscillatory system consisting of a ferrite

cylinder combination are examined too. A comparison of the experimental characteristics of all three types of circulators demonstrates that X-circulators with a combination of resonators and with a ferrite rectangular parallelepiped have better parameters. Figures 3; references 4: 1 Russian, 3 Western.

**Examination of 1/f Noise Sources in Gallium Arsenide and Silicon Avalanche Transit Time Diodes**

927K0012H Nizhniy Novgorod IZVESTIYA  
VYSSHIKH UCHEBNYKH ZAVEDENIY:  
RADIOFIZIKA in Russian Vol 33 No 12,  
Dec 90 pp 1432-1433

[Article by S. A. Kornilov, K. D. Ovchinnikov, A. M. Ripak, Leningrad Telecommunications Institute]

UDC 621.391.822

[Abstract] Flicker noise sources in strong fields in avalanche transit time diodes (LPD) are examined. The validity of Hooge's formula for flicker noise in avalanche

transit time diodes with drift rate fluctuations within a wide range of operating currents, temperatures, and sample volumes is checked. To this end, single-drift-region GaAs and Si Schottky barrier diodes with a  $p^+-n$ -junction were examined. Experiments with gallium arsenide diodes reveal that the flicker component level is affected by the feed current and operating region temperature whereby the level is also a universal function of diode voltage regardless of whether this voltage was attained by changing the temperature or current. This result is illustrated by experimental data for two diodes. An investigation of silicon diodes shows that their flicker component level also depends on the diodes' feed current and their temperature whereby the power of their exponential dependence on current changes from 0.25 to 4 for various diodes. A comparison of these data to Hooge's formula prediction reveals their discrepancy. A consistency of theoretical and experimental data for avalanche transit time diode generators should thus be regarded only as confirming the hypothesis of the drift rate fluctuation being the source of flicker oscillation fluctuations rather than confirming the validity of Hooge's formula for avalanche transit time diodes. Figures 2; references 8: 4 Russian, 4 Western.

### **On-the-Whole Optimal Digital Data Transmission System Decoding and Codes**

927K0029A Moscow *RADIOTEKHNIKA in Russian*  
No 6, Jun 91 pp 3-8

[Article by K. A. Meshkovskiy, A. L. Zalmanov]

UDC 621.391

[Abstract] Data transmission over binary symmetrical channels (DSK) by a method ensuring the highest confidence coefficient of receiving a combination, or the highest probability of correctly decoding a combination, for a given code is considered for the purpose of increasing the noise immunity of digital data transmission. To this end, on-the-whole optimal (i.e., relative to the bit and block confidence coefficient) group codes are constructed for a binary symmetrical channel and the possibility of optimizing the normal table for simultaneously minimizing the block and bit error rates, i.e., on-the-whole optimal decoding, is demonstrated. Comparative error rate calculations for known and new methods are compared. It is shown that decoding on the basis of the normal binary symmetrical channel decoding chart may not be optimal relative to the intelligence character confidence criterion but that by manipulating the principal elements of adjacent normal decoding table classes one can attain on-the-whole optimal decoding. In general, on-the-whole optimal codes ensure a lower bit error rate compared to the codes which are optimal only for the block error rate. Tables 5; references 8: 6 Russian, 2 Western.

### **Beyond-Cutoff Transmission Line-Based Filters Near Cutoff Frequency**

927K0029B Moscow *RADIOTEKHNIKA in Russian*  
No 6, Jun 91 pp 9-12

[Article by S. A. Vyzulin, N. I. Vyrodov, V. V. Zaporozhets, I. I. Timoshenko]

UDC 621.372.822

[Abstract] The need to design filters with a steep amplitude-frequency response (AChKh) slope for microwave (SVCh) discrimination during optimal processing in receiving and transmitting communication channels on the basis of beyond-cutoff waveguides is identified. It is shown that the use of such waveguides which have purely reactive characteristic and input impedance makes it possible to design filters with smaller overall dimensions. To this end, equations are derived for computing the main characteristics of beyond-cutoff filters with a very steep amplitude-frequency response slope near the cutoff frequency allowing for the frequency dependence of the input impedance of transmission lines near the cutoff frequency. The filter is designed on the basis of a section of a beyond-cutoff waveguide which may be filled with a low-loss dielectric in order to decrease its overall dimensions. The filter is shown to have a close to 5 dB/MHz

discrimination near the cutoff frequency without filling. Moreover, the discrimination of a paraffin-filled 11x5.5 mm<sup>2</sup> and nonfilled 23x10 mm<sup>2</sup> waveguides is similar and equal to 1.2 and 2.0 dB/MHz, respectively. Thus, the experiment to fill the waveguide with an isotropic dielectric material demonstrates the feasibility of developing miniature beyond-cutoff microwave (SVCh) filters. Figures 3; references 5: 3 Russian, 2 Western.

### **Wideband Negatron-Based Relaxation Generator**

927K0029C Moscow *RADIOTEKHNIKA in Russian*  
No 6, Jun 91 pp 12-14

[Article by M. I. Bogdanovich]

UDC 621.373:621.374 (088.8)

[Abstract] The shortcomings of existing S-negatron, e.g., dynistor-based relaxation generators, particularly the narrow generation bandwidth leading to low operating stability and reliability and even an oscillation suppression are considered for the purpose of developing and justifying theoretically and experimentally a method of realizing a wideband S-negatron-based relaxation generator with a low current ratio. The design is based on two S-negatrons connected in series whereby one of them has a turn-on current much lower than the turn-off current of the other and each has a low current ratio. It is shown that a series connection of two S-negatrons with different fundamental parameters can be used to attain an equivalent negatron with a  $\xi$ -shaped volt-ampere characteristic which behaves as one S-negatron in the relaxation generator whose turn-on and turn-off current can be controlled individually. It is demonstrated that a relaxation generator realization of the basis of two dynistors is complicated due to the considerable turn-on and turn-off current spread of similar dynistors. Figures 3; references 3.

### **Requirements for Analog-to-Digital Converter on Acoustoelectronic Fourier Processor Output**

927K0029D Moscow *RADIOTEKHNIKA in Russian*  
No 6, Jun 91 pp 26

[Article by G. V. Pevtsov, A. M. Poponin, V. I. Kostetskiy]

UDC 621.7.063:621.37.39.534

[Abstract] The task of determining the requisite time sampling rate and the number of signal envelope sampling bits on the output of acoustoelectronic Fourier processors (AEFP) which arises in the development of computer-aided panoramic receivers and amplitude-frequency spectrum analyzers is considered. Expressions which characterize the linear dependence of the time sampling rate of the signal envelope on the acoustoelectronic Fourier processor output on the linear FM (LChM) generator (LChMG) frequency deviation are derived. The number of analog-to-digital conversion digits is defined and the processor dynamic range is determined allowing for its special crosstalk distortions. The manuscript is available from the Informsvyaz TsNTI in Moscow, reference No. 1762.

**Estimating Radio Pulse Frequency With Unknown Arrival Time***927K0029E Moscow RADIOTEKHNIKA in Russian  
No 6, Jun 91 pp 29-32*

[Article by A. P. Trifonov, A. V. Zakharov]

UDC 621.391

[Abstract] The task of measuring the carrier frequency or Doppler shift of fluctuating radio pulses which arises in many statistical radio engineering applications is addressed; for Gaussian radio signal fluctuations, the problem is reduced to estimating the power spectrum's center frequency shift of the realization segment of a centered Gaussian random process. To this end, two algorithms for estimating the radio pulse frequency are synthesized and analyzed allowing for the possibility that its arrival time is unknown. In so doing, it is assumed that the unknown frequency shift is equiprobably distributed. It is further assumed that there is a synchronization channel independent from the observed realization with a sync pulse of given duration and arrival time being formed on its output. The results enable us to make a sound selection between two multi-channel meters depending on the synchronization channel error as well as the requirements imposed on the frequency estimation accuracy and the meter design simplicity. Figures 2; references 5.

**Optimizing 'Generator-Receiver' Pair at Above Nyquist Transmission Rates***927K0029F Moscow RADIOTEKHNIKA in Russian  
No 6, Jun 91 pp 41-44*

[Article by V. A. Kisel]

UDC 621.391

[Abstract] Synchronous transmission of pulsed signals forming a steady intelligence sequence with a zero mean is considered in order to obtain linear methods of minimizing the beat interference and noise by means of a matched (or joint) selection of receiving and transmitting device characteristics in systems with frequency-limited channels where the pulsed signal transmission rate exceeds Nyquist's rate. To this end, analytical transfer function expressions are derived for a transmitting generator and receiving correcting filter which jointly minimize the sum of additive noise and beat interference variance due to the working frequency band limiting, linear distortions, and phase instability of the communication channel during the transmission of pulsed signals at above Nyquist rates. Separate generator and transmitter and joint generator and receiver optimization are considered and the effect of partial coding is taken into account. The lower beat interference bound variance is estimated. It is shown that at above Nyquist transmission rates, it is possible jointly to analyze optimal frequency responses of transmitting and

receiving units of linear receivers and that at low additive noise levels, several and joint optimizations yield similar results. References 5; 4 Russian, 1 Western.

**Search for Noise-Like Signals With Minimum Frequency Shift Keying***927K0029G Moscow RADIOTEKHNIKA in Russian  
No 6, Jun 91 pp 47-49*

[Article by V. P. Ipatov, A. S. Marugin, V. D. Platonov]

UDC 621.391.25

[Abstract] One of the standard operations performed during the reception of noise-like signals (ShPS) - a signal search in the time domain, i.e., a crude estimate of the delay of the noise-like signal being received relative to the local standard time scale with an error acceptable for subsequently engaging tracking meters - is considered. The efficiency of the noise-like signal search procedures with minimum frequency and phase shift keying is compared and the advantages of minimum FSK (MChM) of noise-like signals over traditional methods of phase shift keying (FM) of noise-like signals in terms of time outlays for the search at a fixed probability of correct outcome as well as under equipment and frequency resource constraints is demonstrated. A single-channel successive search procedure whereby the search is reduced to a step-by-step examination of discrete points on a *a priori* interval is considered. It is shown that under equivalent constraints on the frequency band and identical search procedure confidence requirements, the minimum FSK noise-like signal search calls for considerably smaller time outlays than that of noise-like signals with traditional PSK, this reinforcing the argument in favor of such band-effective noise-like signal modulation methods as minimum FSK. Figures 1; references 6.

**Experimental Investigation of Electromagnetic Wave Scattering by Periodically Uneven Surfaces***927K0029H Moscow RADIOTEKHNIKA in Russian  
No 6, Jun 91 pp 68-70*

[Article by B. A. Ramazanov]

UDC 621.396.667

[Abstract] An experiment carried out in order to determine the shape of the scattering pattern of a periodic uneven surface into the upper half-space where the propagation path is parallel to surface ridges is described. In so doing, the electromagnetic wave scattering is examined on an 8 mm wavelength in a cylindrical scanner in an anechoic room. Data from the receiving antenna was transmitted to the control and recording unit (BUR) and then forwarded to an IVK-8 instrument-computer system for preliminary processing and subsequent printing. The experiment layout is described in detail. Sine-shaped and saw tooth surfaces were investigated at various incidence angles and irregularity periods and heights. The spread of measured pattern points

is consistent with analytical curves; the best results are attained for a surface with a shorter period which is attributed to the sample distortion with a larger period. A comparison of experimental and theoretical data demonstrates that the theory is adequately consistent with the experiment if applicability conditions are met. Thus, given an electromagnetic wave incidence upon a periodic surface along the ridge, the reflected lobes are arranged as a truncated cone surface with a vertex in the middle of Fresnel's zone. Figures 1; tables 1; references 8.

**Investigation of Multimode Short Wave Signal Ergodicity in Ionosphere**

927K0029I Moscow *RADIOTEKHNIKA in Russian*  
No 6, Jun 91 pp 70-73

[Article by A. G. Vologdin]

UDC 621.371.31

[Abstract] Statistical properties of radio signals in the ionosphere are examined allowing for the fact that experimental data can be obtained only by full-scale tests which, as a rule, are irreproducible, as a result of which we are dealing with a single sample rather than an ensemble of realizations. The resulting problem of ergodicity is solved for a stochastic interference model of short wave signals which takes into account the multimode character of the signals and the probabilistic character of their properties. Ergodicity of the stochastic model relative to the mathematical expectation and the correlation and characteristic functions is demonstrated. In so doing, it is assumed that all signal components are statistically independent, the scattered components are steady and ergodic and have a normal probability distribution and a null mean, and random phases of quasiregular components have a uniform distribution law. Moreover, under the above conditions the signal is steady for any number of modes. It is shown that the correlation function ergodicity leads to the variance ergodicity since variance is one of the autocorrelation function's values. In addition, characteristic function ergodicity makes it possible to assert the distribution density ergodicity. Given an infinite number of modes, the signal probability density becomes normal according to the central limit theorem, so the problem of ergodicity turns into a problem of a steady random process with a normal probability density distribution law. References 5.

**Millimeter Wave Band Piezoelectric Ceramic Phase Shifter**

927K0029J Moscow *RADIOTEKHNIKA in Russian*  
No 6, Jun 91 pp 74-76

[Article by A. I. Shalyakin]

UDC 621.372.8

[Abstract] The issue of developing phase shifters for millimeter wave band phased antenna arrays (FAR) is addressed

and the operation of a ceramic piezoelectric phase shifter based on the inverse piezoelectric effect as well as its advantages, such as low active losses and smooth insertion phase shift control, are considered. To this end, basic characteristics of a reflective piezoelectric ceramic phase shifter for phased antenna arrays are examined. The phase shifter under study consists of a rectangular waveguide section, a phase control element, and a shorting switch. The design of each element is described in detail. The phase shifter has minimal transverse dimensions and makes it possible to position all elements densely in the phased array and thus perform wide-angle scanning. The measured partial radiation pattern beamwidth is  $95^\circ$  in the E-plane and  $97^\circ$  in the H-plane at a -3 dB level. Phase shifter tests demonstrate that it can withstand  $10^8$  switching cycles. The reflecting-type shifter has an insertion phase shift of  $315^\circ$ , active losses of less than 0.5 dB, a switching time of 20 ms, and a switching energy of less than 200  $\mu$ J. Figures 4; references 5.

**Measuring Electromagnetic Field Components on Two-Layer Earth Surface Excited by Aerial Wire**

927K0029K Moscow *RADIOTEKHNIKA in Russian*  
No 6, Jun 91 pp 78-80

[Article by V. F. Kalyuzhnyy]

UDC 621.372.5 (075.8)

[Abstract] Axial electric and tangential magnetic field components on the surface of a multilayered earth which for practical purposes is reduced to a two-layer model are considered in order to determine the field components and find the loss power and axial parameters of an equivalent cylindrical return (ground) wire. To this end, a model of an "aerial wire - two-layer earth" line where the flat two-layer earth is substituted with a two-layer cylindrical wire whose radius is equal to the cylindrical electromagnetic field penetration depth in the two-layer cylindrical wire is developed. The resulting expressions for determining the strength components of the electric and magnetic fields on the two-layer earth surface make it possible to calculate the return ground wire impedance allowing for the direct current resistance, skin effect, and conductor convergence effect. It is shown that the overhead wire parameters can also be calculated using these expressions. Figures 2; references 3.

**Diffraction of H-Polarized Planar Monochromatic Wave on Semibounded Planar Waveguide With Infinite Plane**

927K0043A Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian* Vol 36 No 5, May 91 pp 849-856

[Article by Ye. A. Galstyan, O. V. Gornostayeva]

UDC 537.874.6:672.8

[Abstract] The issues of exciting a semibounded planar waveguide with an infinite flange and analyzing the radiation emerging from it are addressed; in particular, diffraction of an H-polarized monochromatic planar wave incident



upon a planar semibounded (parallel plate) waveguide with an infinite flange at a given angle is analyzed by the Wiener-Hopf method in Jones's formulation whereby the waveguide walls are regarded to be perfect conductors and the field inside the waveguide is described by the classical sewing method as an expansion in terms of eigenmodes. In so doing, a system of functional equations is derived and reduced to infinite systems which are subsequently solved by the reduction method. The frequency dependence of the waveguide's effective absorbing surface for various external wave incidence angles and the field amplification in the waveguide's aperture as a function of the ratio of incident radiation wavelength and waveguide dimensions are presented. Figures 5; references 9: 7 Russian, 2 Western.

### Transient Processes in Wire Antennas With Pulsed Excitation

927K0043B Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 861-868

[Article by I. P. Kovalev, D. M. Ponomarev, Ye. A. Klyuyev]

UDC 621.396.67.01

[Abstract] Antennae and antenna systems under the effect of short pulses are investigated and their advantages over antennae systems excited by harmonic signals are considered. To this end, a model is developed on the basis of the concept of the physical processes occurring in wire antennas, which makes it possible to analyze such antennae's field both in the far and near field regions. In particular, transient processes in such antennae under the effect of pulsed excitation are considered and their transient responses are computed using a charge model. The interaction of two dipole antennae under a pulsed excitation is investigated analytically and experimentally. It is shown that the experimental results corroborate theoretical data. The design of an experimental unit consisting of a cone located at a center of a disc and connected to an oscillator and two rod antennas is described. Figures 4; references 4.

### On Synthesizing Optimal Amplitude-Phase Distributions for Microwave-Beam Power Transmission Circuit

927K0043C Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 869-875

[Article by V. A. Vanke, A. A. Zaporozhets]

UDC 621.385.6.01

[Abstract] The method of synthesizing the field amplitude distribution (AR) on the transmitting antenna's power circuit (TPE) by a microwave (SVCh) beam which corresponds to the maximum efficiency (KPD) of power transmission (or concentration factor) while meeting a number of requirements imposed on the radiation pattern (DN) is addressed. The possibility of extending this method to synthesizing amplitude-phase distributions

(AFR) is considered; the results of synthesizing a radiation pattern with an "undulating" apex and a given side lobe level are cited for illustration. The cases where the power transmission circuit characteristics can be improved by including the phase distribution (FR) in the optimization procedure are discussed. The conditions making it possible to fix the radiation pattern amplitude at set points which determine the radiation pattern extrema positions and the equality to zero of four derivatives at the  $u=0$  point used for synthesizing the most planar radiation pattern are examined. It is shown that the inclusion of the phase distribution in the optimization procedure makes it possible to increase efficiency by 20 percent and reduce the side lobe level by 12 dB. Figures 2; references 6: 4 Russian, 2 Western.

### Electromagnetic Wave Diffraction on Perfectly Conducting Wedge With Inhomogeneous Ferrite Dielectric Cap

927K0043D Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 876-883

[Article by V. N. Kisel, A. I. Fedorenko]

UDC 537.874.6.01

[Abstract] Two versions of the integral equations (IU) method developed for numerically solving the problems of electromagnetic wave (EMV) diffraction on semi-infinite bodies are discussed. The use of integral equations for describing an inhomogeneous ferrite dielectric coat on the edge of a perfectly conducting wedge is considered. In particular, surface and bulk integral equations are combined for solving in a strict formulation the two-dimensional problem of planar electromagnetic wave diffraction on such a wedge with an inhomogeneous dielectric tip. The coat parameters do not depend on the edge's Cartesian  $z$ -coordinate. An efficient algorithm is suggested for calculating the improper integrals underlying the use of the integral equations technique for scatterers with semi-infinite surfaces. The result of algorithm tests and examples of the effect of inhomogeneous tips on the scattering properties of a semi-infinite metallic bar are cited. The effect of the ferrite dielectric tip design on the backscattering pattern of the perfect semi-infinite bar is illustrated. Figures 4; references 12: 6 Russian; 6 Western.

### Radar Sensing of Agitated Water Surface in Basins of Finite Dimensions

927K0043E Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 884-890

[Article by F. G. Bass, G. M. Pritula]

UDC 621.396.96:551.48

[Abstract] Experiments with radar sensing of lake and river surfaces in which the shape of the bottom as well as the closed and complex shape of the coastline are taken into account are described and an attempt is made to

study waves on the water surface caused by either the wind or earthquakes. In so doing, electromagnetic wave scattering on the surface of reservoirs of finite dimensions is examined in the perturbation method approximation. As a result, formulae for the electromagnetic radiation scattering cross section of the agitated water basin surface of finite dimensions are derived and the effect of the reservoir's side wall shape is taken into account assuming that the bottom is flat. The effect of changes in the reservoir bottom shape as a function of space and time on electromagnetic wave scattering is investigated. It is demonstrated that statistical bottom shape irregularities may result in the line broadening of the electromagnetic radiation scattered by the water surface. It is shown that the scattering approximation is applicable when the characteristic irregularity height on the water surface is small compared to the electromagnetic wavelength while the irregularities are mildly sloping. Figures 1; references 7: 6 Russian; 1 Western.

**Cloudy Atmosphere Sensing Over Ocean From Space by Microwave Radiometer: Effect of Antenna Smoothing**

927K0043F Moscow *RADIOTEKHNIKA I ELEKTRONIKA*  
in Russian Vol 36 No 5, May 91 pp 891-901

[Article by L. M. Mitnik, M. Yu. Shum]

UDC 551.510:621.396.962.4

[Abstract] The use of microwave (SVCh) radiometers in environmental studies involving remote sensing from space whereby geophysical parameters are estimated by measuring the intensity of the escaping thermal RF radiation of the underlying surface/atmosphere system at several frequencies is addressed. The smoothing of signals recorded on the satellite due to the limited size of antennae and the presence of an integrating network, e.g., a low-pass filter, is considered. The results of numerical experiments aimed at estimating the effect of antenna-induced smoothing of the radiance temperature variations of the ocean/atmosphere system's radiance temperature are discussed and these variations are attributed to the variability of the vaporized and condensed moisture content in the atmosphere. Data obtained by satellite radiometers with a high spatial resolution are simulated on the basis of footprint surface RF thermal radiation measurements of the clouded atmosphere taken on a  $\lambda=2.3$  cm wavelength from ships. Figures 5; tables 1; references 17: 12 Russian, 5 Western.

**Dependence of Wideband Array Directivity Patterns on Fast Fourier Transform Algorithms**

927K0043G Moscow *RADIOTEKHNIKA I ELEKTRONIKA*  
in Russian Vol 36 No 5, May 91 pp 902-908

[Article by V. G. Gusev]

UDC 621.369.67.01

[Abstract] The need to detect and estimate the parameters of wideband signals received within a certain angular sector by wideband antenna arrays (AR) in which a set of beams - the directivity pattern (KhN) - is formed for scanning a given sector is addressed and the receive array beamformer (UFKhN), a device which shapes the directivity pattern and solves the problem of planar wave signal energy localization, is described. It is shown that the function of beamforming is realized by the fast Fourier transform (BPF) algorithms defined on discrete samples of finite space and time intervals. The effect of these factors on the directivity pattern distortions is analyzed and it is demonstrated that they appear due to limiting the sampling and representation interval of temporal field realizations on array elements. The resulting mathematical relations make it possible to produce quantitative estimates of the directivity pattern distortions and thus justify the selection of such FFT algorithm parameters as the number of time sequence points to be transformed and the sampling interval. The use of two- and three-dimensional FFT algorithms for forming the directivity pattern of linear and planar arrays, respectively, does not lead to additional pattern distortions compared to the case where it is formed by a one-dimensional FFT algorithm which ensures a transition from the time domain to the frequency domain. Figures 1; tables 1; references 5.

**Method of Markov-Group Filtering of Moving Target Parameters**

927K0043H Moscow *RADIOTEKHNIKA I ELEKTRONIKA*  
in Russian Vol 36 No 5, May 91 pp 927-934

[Article by Yu. G. Bulychev, A. P. Manin]

UDC 621.396:621.391

[Abstract] The problem of analyzing and synthesizing prospective systems for estimating the trajectory parameters of moving targets using the theory of nonlinear filtering and its shortcomings are discussed. A new method of estimating the moving target parameters developed on the basis of jointly taking into account the Markov properties of nondifferentiable (in a general sense) components and group properties of smooth components of the generalized state vector is described; the method makes it possible partially to overcome the shortcomings of the traditional methods of optimal nonlinear filtering. The new method combines the advantages of group representation of smooth state vector components with those of Markov's approach and makes it possible rather easily to synthesize optimal and quasioptimal algorithms and signal processing designs in the framework of the existing nonlinear filtering theory. It is shown that the method may be further improved by developing efficient Markov group target motion models on the basis of complex continuous transformation groups characterized by the requisite "adaptability" in given directions, i.e., a large number of degrees of freedom. References 6.

### Synthesis of Receiver of Discrete $M$ -Base Messages Transmitted by Radio Signal With Pseudorandom Carrier Frequency Switching

927K0043I Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 935-941

[Article by V. I. Prytkov, G. I. Tuzov]

UDC 621.391.01

[Abstract] Transmission and reception of discrete messages by means of the  $M$ -base frequency modulation with quasirandom carrier frequency switching (M-ChM/PPRCh) is addressed. A receiver of  $M$ -base discrete messages transmitted by the M-ChM/PPRCh method is synthesized with the help of Markov's theory of optimal nonlinear filtering. A receiver design realization is proposed; it differs from previous designs by the nonlinear weighted composition of signals in  $M$  channels, thus making it possible to process noise channels by assigning a lower weight to them. It is noted that the synthesized receiver is characterized by a delay in the signal delay tracking circuit which leads to distortions in the tracking circuit's discrimination characteristic, thus decreasing the tracking accuracy and stability. This delay can be compensated by altering the frequency switching order in the frequency synthesizer (SCh) if it is a multiple of one frequency element and by entering the signal from the tunable clock driver (UTG) through a compensating delay line to the switch if the delay is not a multiple of  $T_0$ . Figures 1; references 6.

### Certain Prospective Microwave Electronic Device Designs

927K0043J Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 942-951

[Article by A. A. Kurayev, B. M. Paramonov, A. K. Sinitsyn]

UDC 621.385.6.01

[Abstract] A number of physical phenomena and principles of controlling the electron current in diverse, highly efficient microwave (SVCh) electronic devices which make it possible to propose new potentially efficient designs are summarized. In particular, three types of devices are summarized: 1) a frequency doubling klystron with lateral modulation (KPM) which makes it possible to solve two relativistic electronics problems - decreasing the amplitude level modulating a relativistic electron beam (REP) of the input resonator field and shortening the device; 2) gyrotrons or multistage amplifiers, and 3) O-type traveling wave tubes (LBV-O) with an irregular slow-wave structure. These devices' operating principles and advantages are examined. Figures 5; tables 1; references 24: 23 Russian, 1 Western.

### Simulation of Microwave Heating of Inhomogeneous Media With Phase Transition

927K0043K Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 960-964

[Article by V. N. Makarov, V. A. Nedelko, L. M. Nutovich]

UDC 621.385.6.017.71

[Abstract] The changes in the phase state of dissipative media under microwave (SVCh) heating and the appearance of higher temperature gradients during phase transitions due to a change in the electric properties of the medium in the phase transition zone by one-to-two orders of magnitude are discussed. The need to develop a numerical model of the process combining microwave heating with a simultaneous cooling of the medium's surface is identified. The results of an investigation of such a combined effect are presented using the example of a water-containing medium undergoing a transition from the solid (frozen) to the liquid phase. The assumptions made in developing the initial computational model are described. The problem is simulated by a self-consistent numerical method of computing the temperature distribution during the microwave heating of a dissipative medium with phase transitions whereby electric and thermal fields are analyzed by the successive approximation method. It is shown that the heating irregularity caused by the microwave field attenuation in the near-surface layer can be decreased considerably by cooling the medium's outer surface and properly controlling the ambient temperature and microwave field amplitude in the time domain. The resulting data make it possible to review the design principles of microwave devices intended for heating media with phase transitions. The numerical analysis method can be extended to other media by properly substituting the medium's parameters and characteristics. Figures 2; references 6: 5 Russian, 1 Western.

### Emission Properties and Lifetime of Dispenser Cathodes

927K0043L Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 36 No 5, May 91 pp 985-993

[Article by B. Ch. Dyubua, Ye. M. Zemchikhin, A. P. Makarov, O. K. Kultashev, Ye. D. Kuranova, O. V. Polivnikova]

UDC 537.533.2

[Abstract] The need for durable cathodes operating under high current takeoff conditions at reduced temperatures which are resistant to poisoning by residual gases and the effect of ionic and electronic bombardment as well as have low and stable values of the first critical potential, a high secondary electron emission ratio (KVEE), a low vaporization rate, and a large store of active substance is identified. Thermionic and secondary

emission properties, lifetime, active substance vaporization rate, and surface composition of three types of dispenser cathodes (MPK) are examined comprehensively and compared to each other: naked, coated with an osmium film, and bulk-treated with osmium. It is shown that dispenser cathodes coated with osmium or osmium-based alloy films have the best thermionic and secondary emission properties yet their lifetime is much shorter than that of uncoated dispenser cathodes at the same temperature. A correlation between emission properties and their stability on the one hand and the vaporization rate and surface composition of the three types of dispenser cathodes studied on the other is established; the results are attributed to the existence of different emitting phases on the surface of these cathodes. The operating mechanism of these cathodes is interpreted. It is noted that the oxygen/barium Auger peak ratio is greater on the surface of electrodes coated with osmium-hafnium and rhenium-hafnium alloy films than on other electrodes studied, attesting to the presence of bulk barium-oxygen formations on their surface and possibly, to their elevated secondary emission properties. Figures 4; tables 2; references 10: 6 Western; 4 Russian.

**Antenna's Pulsed Radiation (Electromagnetic Missile)**

927K0043M Moscow *RADIOTEKHNIKA I ELEKTRONIKA*  
in Russian Vol 36 No 5, May 91 pp 1014-1022

[Article by L. G. Sodin]

UDC 621.396.67.01

[Abstract] Radiation of short pulses by antennae described in the past five years in American publications whose authors introduced the new concept of "electromagnetic missile" (ES) are discussed. The electromagnetic missile phenomena are examined more comprehensively and in greater detail while some hitherto rather flawed pulsed radiation descriptions found in the aforesaid publications are clarified. The physical essence of electromagnetic missile phenomena is explained as follows: the far boundary of Fresnel's zone loses its sense at certain parameters whereby the high energy concentration typical of Fresnel's zone, i.e., the absence of a wave beam divergence, may also be observed at a very long range. Radiation of an antenna excited by a short extraneous current pulse is investigated and the spatial and temporal characteristics of the electromagnetic field are analyzed. The conditions under which the above high energy concentration is observed within narrow space and time intervals are identified. The above analysis clarifies the principal correlation between the radiating antenna aperture characteristics, the type of exciting pulse, and the pulse field properties; since the high energy concentration problem is related to the problem of exciting the antenna by a pulse with a "steep" front, the task of investigating transient processes in the antenna and searching for ways of reducing them becomes important. The author is grateful to P.V. Bliokh for discussing the issues. Figures 6; references: 5 Western.

**Diffraction on Fine Rectangular-Cell Metal Gratings With Finite Conductivity**

927K0043N Moscow *RADIOTEKHNIKA I ELEKTRONIKA*  
in Russian Vol 36 No 5, May 91 pp 1026-1029

[Article by A. A. Kovalev, P. S. Kondratenko, B. N. Levinskiy]

UDC 537.874.6.01

[Abstract] The effect of finite metal conductivity on the diffraction of electromagnetic waves incident upon a fine grating with a rectangular profile is discussed due to the interest in the resonant surface electromagnetic wave (PEV) excitation on the grating. A general approach which makes it possible to obtain an analytical solution of the problem of diffraction on fine metal rectangular-shape gratings which successively takes into account the metal's finite conductivity is formulated. For simplicity's sake, the easiest case where the incident wave is *p*-polarized while the projection of the incident planar electromagnetic wave's wave vector upon a nondisturbed surface is directed along the *x*-axis parallel to the reciprocal grating's vector is considered. The metal's surface impedance parameter is contained in matrix equations of the diffraction problem just as in the case of gratings with a smooth profile, thus justifying the type of resonance denominator used for describing the surface electromagnetic wave excitation in rectangular gratings. Figures 1; references 3: 1 Russian, 2 Western.

**Modification of Auxiliary Sources Method for Solving Three-Dimensional Vector Scattering Problems**

927K0043O Moscow *RADIOTEKHNIKA I ELEKTRONIKA*  
in Russian Vol 36 No 5, May 91 pp 1032-1036

[Article by A. G. Dmitriyenko, A. I. Mukomolov]

UDC 537.874.6.01

[Abstract] A version of the method of auxiliary sources (VI) for solving the problem of electromagnetic scattering on randomly smooth conducting bodies which is characterized by selecting electric dipoles located on the auxiliary surface similar to the scatterer surface and oriented tangentially to the latter as the auxiliary sources as well as by using a system of algebraic linear equations and subsequently finding its pseudosolution by minimizing the square of its error vector norm by iterative methods in order to determine the dipole moments is considered. The method is further developed by introducing a set of tangentially oriented magnetic dipoles whereby at each selected point on the auxiliary surface a pair of dipoles - one magnetic and one electric - is permitted. The use of such combined auxiliary sources expands the method's applications and increases the solution accuracy of the aforesaid scattering problem. The method was used to solve the scattering problem of

an obliquely incident electromagnetic wave upon a tri-axial ellipsoid with constant and variable surface impedance. Figures 2; references 3.

#### Noise Immunity Analysis of Combined Wide-Band Composite Signal Processing Circuit in Channels With Fluctuating and Concentrated Noise

927K0032A Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 34 No 4, Apr 91 pp 13-17

[Article by A. V. Astapenko, V. V. Ignatov, V. G. Melnikov]

UDC 621.391.23.019.4

[Abstract] Systems of combined processing (SKO) of composite wide-band signals whereby coherent convolution of a part of the signal is combined with subsequent noncoherent processing of the composite signal formed from elements resulting from the coherent convolution are discussed. The noise immunity of a circuit for combined detection of two orthogonal wide-band signals (SShPS) under the joint effect of fluctuating and spectrally concentrated noise is analyzed. As a result, formulae are derived which determine the probability of erroneous discrimination of composite orthogonal wide-band signals by a combined processing circuit under the effect of fluctuation noise as well as the joint effect of fluctuation and spectrally concentrated noise. The dependence of energy losses on the composite signal's base distribution and the degree of concentrated noise band narrowness is analyzed. An expansion of the combined noise spectrum width affecting the combined processing circuit at a constant power leads to a decrease in energy losses due to a reduction in the interference and signal nonorthogonality noise. Given a PSK noise, said energy loss decrease amounts to 0.7-2 dB. Figures 3; references 4.

#### Noise Immunity of Satellite Communication Systems With Code Signal Division

927K0032B Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 34 No 4, Apr 91 pp 18-22

[Article by V. S. Gutin]

UDC 621.396.2

[Abstract] The issue of multiple access in mobile radio (e.g., maritime) satellite communication systems by means of structural (code) signal division which makes it possible to realize the asynchronous address data transmission principle and ensure free, or unrestricted, repeater access for a large number of independent territorially spaced subscribers is addressed. A technique is proposed for analyzing the noise immunity of satellite communication systems with code signal division which takes into account the stochastic variability of a number of radio link parameters, e.g., traffic. It is shown that by jointly taking into account the statistical characteristics of fluctuating parameters we attain advantages over a method of separately fixing the legitimate values

of each parameter. In considering the radio link, it is assumed that the mean number of subscribers serviced is much smaller than their total number; that composite PSK (FM) signals are used whereby each signal's code sequence is the subscriber's address character; that messages are transmitted digitally by bursts of equal duration and power at a given rate; the signal powers from earth stations are equalized on the repeater input; that rigid baseband signal limiting is used in the repeater circuit; and that signals on the receiving end are separated by means of cross-correlation processing. References 6.

#### Polarization Characteristic of Radar Signal Scattering by Sea Surface

927K0032C Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 34 No 4, Apr 91 pp 26-31

[Article by N. N. Badulin, V. L. Gulko]

UDC 621.396.96

[Abstract] The development of noncontact methods of measuring the sea surface characteristics and the problem of sea clutter in solving navigation and other tasks by means of radar facilities are addressed. The results of an experimental investigation of two types of polarization-modulated (PM) signal scattering by the sea surface are presented and an attempt is made to describe analytically the sea surface's polarization properties by complementing a known model. This made it possible to obtain theoretical estimates of certain polarization-modulated radar signal scattering characteristics and compare them to experimental data. A research vessel radar operating in the 3 cm band equipped with a polarization modulator and a spectrum analyzer was used in the experiments. Experimental unit components and their design are described in detail. Experimental data indicate the possibility of obtaining information about the agitated sea surface with the help of polarimetry methods which can be implemented more easily than amplitude methods since they do not call for measuring the echo signal strength. Figures 2; references 4.

#### PSK Radar Signal System

927K0032D Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 34 No 4, Apr 91 pp 37-42

[Article by V. I. Lityuk, V. Ya. Plekin, A. V. Ovseyenko]

UDC 621.396.96

[Abstract] The processing of phase shift keyed signals (FMS) represented as a matrix product unconstrained by the consistent processing condition is considered allowing for its practical implementation. In a general case, PSK signal processing can be reduced to computing the combined mutual ambiguity function (KVFN) of a system of signals. To this end, systems of radar PSK signals with a "quasiperfect" shape of the combined mutual ambiguity function are

investigated and the problem of attaining a "quasiperfect" combined mutual ambiguity function shape is solved in a general form. For illustration, an example of time-division multiplexing of PSK signal systems is considered in the case where the Doppler shift differs from zero. A block-diagram of the FMS signal system processing circuit and the operating principles of its components are presented. In this case the combined mutual ambiguity function characterizes the response of the PSK signal system processor in the presence of a Doppler shift. Thus, the possibility of attaining a "quasiperfect" shape of the PSK signal system KVFN is demonstrated. The use of the matrix approach to describing the PSK signal system makes it possible to realize more fully potential characteristics of coherent radar (RLS) in solving the problems of signal detection, resolution, and measurement and increases such radar's noise immunity due to a coding sequence substitution. Figures 2; references 6: 3 Russian, 3 Western.

#### **Estimating Trajectory Parameters by Mobile Direction-Finder Angle Measurements**

927K0032E Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 34 No 4, Apr 91 pp 51-56

[Article by Yu. G. Bulychyev, A. A. Korotun, A. P. Manin, V. A. Motorkin]

UDC 621.396.96

[Abstract] The use of new approaches to processing radar data in passive goniometric systems in order to improve their efficiency are discussed and their shortcomings - particularly the fact that they solve the intermediate tasks of estimating motion direction cosines, compensating for systematic errors, and identifying goniometric data rather than locating the targets and estimating their trajectory parameters - are summarized. A new method of locating targets and estimating their trajectory parameters on the basis of goniometric data obtained by a sole mobile direction-finder is proposed. The method is devoid of the constraints characteristic of traditional approaches. The geometric relationships characterizing the problem are presented. The method is illustrated using an example of a target moving along a straight line where the mobile direction-finder's points of sight do not lie on the same plane. A numerical experiment was conducted and confirmed the efficiency of the above trajectory estimation method under the conditions maximally approximating the real mobile direction-finder operation against the background of inevitable fluctuation errors. Figures 4; references 3.

#### **Investigation of Complex Monopulse Direction-Finder Errors**

927K0032F Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 34 No 4, Apr 91 pp 70-72

[Article by V. A. Kochetkov, Ye. P. Parunakian, D. N. Romazanovich]

UDC 621.396.663

[Abstract] Specific instrumental errors of the complex direction-finding method which appear due to interrelation of angular data in the instrument's channels and depend not only on the coordinate being measured by this channel but also on the coordinate being measured by the other channel are addressed. Generalized expressions are derived for the complex direction-finder errors allowing for the possible nonidentity of channel amplitudes and phases. The results of an error analysis performed with the help of the above generalized expressions are cited. The dependence of systematic errors in the complex monopulse direction-finder channels on the controlling coordinate calculated for a set of phase characteristics nonidentities and gain factors is shown. The resulting formulae make it possible to estimate the direction-finding error at the early design stage and outline methods for increasing the accuracy of complex direction finders, e.g., the RF circuit gain equalization and phase identification of RF and IF channels. Figures 2; references 1.

#### **Estimating Point Radiation Source's Angular Coordinates and Field Intensity in Half-Space**

927K0032G Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 34 No 4, Apr 91 pp 72-74

[Article by A. A. Pykhalov, V. T. Sarychev]

UDC 537.872.32::621.3.095.22

[Abstract] The problem of finding the spatial distribution of radiation sources and determining their field intensity at the reception point by the amplitude-phase distribution (APD) of the field recorded on the planar antenna array (AP) aperture using a traditional two-dimensional Fourier transform or modern high-resolution spectral methods and their shortcomings are discussed. An economical algorithm of estimating the angular and energy parameters of radiation sources distributed in a half-space is presented. To this end, a planar array whose two orthogonal sides coincide with the  $OX$  and  $OY$  axes containing equidistant elements whereby radiation from the sources is incident upon its aperture as a set of planar waves is considered. The proposed processing algorithm is divided into two stages - estimating the number of sources by the number of spectrum maxima and their position and determining the unknown complex amplitudes contained in the amplitude-phase distribution model. The algorithm was tested on a computer (EVM) whereby a half-wave equally spaced array consisting of  $5 \times 5$  elements was simulated. It is shown that the algorithm is sufficiently fast and makes it possible to locate sources in a half-space in the presence of two parallel linear arrays. Figures 2; references 4.

**Multiple Weighted Processing of Systems of PSK Signals**

927K0032H Kiev IZVESTIYA VYSSHIKH  
UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 34 No 4, Apr 91 pp 78-80

[Article by V. Ya. Plekin, A. V. Ovseyenko]

UDC 621.396.96

[Abstract] The increasing use of phase shift keyed (FM) signals which ensure given autocorrelation function (AKF) properties, e.g., a lower sidelobe level, is discussed. A method of multiple weighted processing of a system of PSK signals on the basis of Barker's code which makes it possible to decrease considerably the residual sidelobe level of the composite autocorrelation function is examined. To

this end, single weighted processing of a system of PSK signals on the basis of Barker's code which may be reduced to forming two weighted replicas of the composite autocorrelation function and summing them with the original composite autocorrelation function is analyzed. The method of single weighted processing is illustrated by an example of 13- and 11-digit Barker codes showing that each weighted processing step decreases the sidelobe level by roughly 27.6 dB. It is noted that the composite autocorrelation function length increases with each step resulting in a corresponding increase in the PSK signal processing time; consequently, the weighted processing ratio must be selected from a compromise between the requisite residual sidelobe level and the time for forming the compressed and weighted PSK signal. If the sampling ambiguity is resolved, the method improves radar and communication system performance. Figures 1; references 2.

**VL85 Experimental Electric Locomotive**

917K0292A Moscow *ELEKTRICHESKAYA I  
TEPLOVOZNAYA TYAGA in Russian No 1,  
Jan 91 pp 38-40*

[Article by A. M. Rutshteyn and A. A. Shchupak, candidates of technical sciences, and A. A. Babin, engineer, All-Union Electrical Scientific Research Institute]

UDC 629.423.1.048.4:621.311.004.18

[Abstract] Although the possibility and desirability of saving power in operation of electric locomotives by use of frequency-controlled ventilation systems has long been recognized, standard use of such systems has not been the practice in the USSR, partly due to an under-rating of the contingent efficiency, partly due to deficiencies in semiconductor instruments and power capacitors, making it impossible to adopt state of the art technology. The feasibility of using two-stage regulation of supply current frequency for motor-fans, employing direct frequency and phase number converters, was for the first time validated by specialists of the All-Union Scientific Research Institute of Railroad Transportation as early as the 1970's. This proposal was never realized due to the inadequate reliability of known current conversion systems. A new, very simple converter has been developed. In comparison with those already in use, it has a reduced quality of the output voltage but it does not require galvanic decoupling from the power network. Some increases in additional electrical losses in the motors is compensated for by multiple reduction in load power, and accordingly, lessening of the main electrical losses. Detailed circuit diagrams are presented, supplemented by textual descriptions and explanations. A system of auxiliary machines developed on the basis of this converter underwent thorough testing in electric locomotives of different types and was used in constructing the VL85 electric locomotive in 1989. The successful operation of the locomotive on the Northern Caucasus Railroad and on the Baykal-Amur Mainline revealed a high efficiency of the developed drive system and its reliability. The savings in electrical power in train propulsion over one test period was 5.6 percent (varying from 2 to 17 percent, depending on train weight and terrain conditions) and there was a great reduction in fan noise

in the locomotive cab. A series of such locomotives is planned for production in 1991. Figures 2.

**Increasing Safety in Inspecting Electrical Equipment**

917K0292B Moscow *ELEKTRICHESKAYA I  
TEPLOVOZNAYA TYAGA in Russian No 1,  
Jan 91 pp 42-44*

[Article by A. N. Bychkov, candidate of technical sciences, Moscow Institute of Railroad Engineers]

UDC 658.345:621.331:621.311.4

[Abstract] Countless injuries occur annually during the inspection of electrical equipment, sometimes with a fatal outcome. Several such incidents are described with an explanation of the probable cause for the injuries (in most cases due to severe infractions of safety rules already in force, sometimes due to lack of experience on the part of inspectors). This article outlines the procedures for inspection of electrical equipment and gives recommendations on improving the color coding of electrical equipment components and ways to prevent fires in electrical equipment. The environmental factors (wind, glaze, snow, dust) responsible for dangerous irregularities in equipment are briefly discussed. The potential existence of threatening conditions dictates that the inspector adhere to a rigorous discipline in approaching and coming into contact with any equipment. Although in general the presence of malfunctions or irregularities in equipment integrity and operation should be indicated by instrument readings on the control panel, this must not disarm the inspector, relaxing his vigilance, because serious hidden defects may be present. There is a certain mental attitude, a constant alertness, which must govern every inspection procedure. Examples of dangerous situations, resulting in severe trauma, are given. Suggestions are made on improved color coding of specific electrical components which, since 80-90 percent of all information is received visually, is believed will assist in the inspection process, aiding in avoiding misidentification blunders. Clues as to presence or nature of problem situations are discussed. The need for a refresher course in work safety procedures is stressed, particularly essential if the inspector has been away from his job due to illness or other causes. Since fires in and around electrical equipment are a serious problem, like electrical shock, the ways to prevent electrical fire injuries are stressed.



**Microelectronic Technologies: Main Road to Developing Chemical Solid State Sensors***927K0007A Moscow MIKROELEKTRONIKA in Russian Vol 20 No 4, Jul-Aug 91 pp 337-355*

[Article by V. M. Arutyunyan, Yerevan State University]

UDC 621.382

[Abstract] Analytical methods employing electrodes sensitive to various ions, enzymes, or gases and the need to adapt them to the operation of today's computer and microelectronics systems are discussed. It is stressed that the miniaturization of chemical sensors for various ions and gases often calls for rejecting traditional approaches and using new physicochemical and physical processes and utilizing modern microelectronics which makes it possible to produce large batches of inexpensive instruments while reducing the specific consumption of energy and materials for the analyzers. Among the sensors already produced for portable highly reliable multichannel devices, attention is focused on sensors for selective and integral detection of such substances and processes as ion-, ferment-, immunoselective, and other electrodes for examining the kinetics and chemical, catalytic, and biochemical reactions, diffusion, and other mass transfer phenomena and controlling chelation, ion association, studying changes in the ion composition within and without live cells, monitoring environmental contamination, etc. It is shown that these new applications of semiconductor microelectronics and methods for developing chemical sensors are rapidly improving and are expected to become cheaper and more efficient. Figures 7; tables 1; references 42: 21 Russian, 21 Western.

**Matrix Multiplier LSI Circuit With Threshold and Multivalued Logic Elements***927K0007B Moscow MIKROELEKTRONIKA in Russian Vol 20 No 4, Jul-Aug 91 pp 370-376*

[Article by A. B. Kmet, V. I. Medvedev, G. M. Stadnik, A. I. Sukhoparov, Integral Production Association]

UDC 621.3.049.771.14

[Abstract] Interest in threshold and multivalued logic elements prompted by the development of integrated injection logic ( $I^2L$ ) circuits is discussed. The results of an investigation of the possibility to realize IC's using elements of isoplanar  $I^2L$  circuits ( $I^3L$ ) with an isolation of threshold and four-valued logic are presented using the example of a matrix multiplier. The logic circuit operation range is determined and the requirements imposed on circuit element parameters are established. For the first time, matrix multiplier LSI circuits (BIS) executed on threshold and multivalued logic elements using the  $I^3L$  technology are produced. The parameters of two types of LSI circuits are investigated experimentally: with silicon resistors and resistors in the  $p$ -layer base. An eight-digit number multiplication time of under 300 ns is attained while in the pipelining mode the cycle

is shortened to 150 ns. Multiplier IC's maintained serviceability within  $-50^\circ\text{C}$  to  $+120^\circ\text{C}$ . Figures 5; references 3: 1 Russian, 2 Western.

**Effect of Active Layer Parameters on FET Microwave Noise***927K0007C Moscow MIKROELEKTRONIKA in Russian Vol 20 No 4, Jul-Aug 91 pp 377-382*

[Article by A. B. Pashkovskiy, Istok Scientific Production Association]

UDC 621.382

[Abstract] The role of the minimum noise factor - one of the most important RF parameters of gallium arsenide Schottky barrier field effect transistors (PTSh) - and the problem of determining the dependence of the minimum noise factor on the transistor structure parameters are discussed. In particular, the dependence of  $F_{\min}$  on the transistor's active layer parameters is investigated for a transistor with a  $0.25\ \mu\text{m}$  long and  $100\ \mu\text{m}$  wide gate. It is shown that  $F_{\min}$  and forward gain are most affected by the donor concentration, electron mobility, and spurious resistance in the active layer. The electron mobility in the buffer layer (BS) has a smaller effect on  $F_{\min}$  although its effect on forward gain may be greater. An optimal structure of low-noise microwave (SVCh) Schottky barrier field effect transistors must have a doping profile close to uniform since stepped profile does not have significant advantages. Figures 5; references 10: 4 Russian, 6 Western.

**Effect of Lateral Spatial Electron Transport on High-Frequency Characteristics of Selectively Doped Heterostructure FET***927K0007D Moscow MIKROELEKTRONIKA in Russian Vol 20 No 4, Jul-Aug 91 pp 383-391*

[Article by A. A. Kalfa, A. B. Pashkovskiy, A. S. Tager, Istok Scientific Production Association]

UDC 621.382

[Abstract] The use of selectively doped heterostructures (GSL) in field effect transistors (PT) and transistor structure optimization, particularly by using mathematical modeling, in order to improve the output characteristics of selectively doped heterostructure FET's are discussed. A simple model of a selectively doped heterostructure FET which not only adequately describes the processes occurring in the transistor and produces results consistent with the experimental outcome but also is sufficiently simple so as to perform the optimization procedure in a reasonable time span is described. The model also takes into account the dimensional electrons' energy spectrum quantization, their unsteady drift, and spatial transport between the heterostructure's layers. A selectively doped heterostructure FET with a  $0.5\ \mu\text{m}$  long gate was examined. The resulting quasibivariate hydrodynamic model of the selectively

doped heterostructure FET made it possible to attain an adequate consistency of theoretical data and experimental values of the volt-ampere characteristic (VAKh) and equivalent circuit parameters as well as noise factor and gain. It is shown that spatial electron transport between the heterostructure's layers may substantially alter the electron drift rate, energy, and concentration distribution in the transistor channel and noticeably affect its output characteristics. Figures 5; tables 1; references 23: 14 Russian; 9 Western.

### **Design Principles of Incoming and Production Control of Digital LSI Circuits and Master Array Chip Facility Complex**

927K0011A Moscow *PRIBORY I SISTEMY*  
*UPRAVLENIYA* in Russian No 3, Mar 91 pp 18-20

[Article by V. V. Danilov, D. G. Dobrovinskaya, V. Ya. Yerokhov, G. I. Lobanov, V. S. Punkevich, L. M. Rutshteyn, Instrumentation Science Research Institute, Penza]

UDC 681.32.9.08

[Abstract] A complex of incoming and production control facilities for digital LSI circuits (BIS) and master array chips (BMK) consisting of a number of units - Karat-24, Karat-64, Karat-128, and Karat-256 - which have identical structures, a common system data bus from the control computer (EVM), and a high degree of hardware and software standardization but different inspection frequencies (from 20 to 40 MHz) and a varying number of duplex input/output channels (from 24 to 256) is described. Karat system specifications are summarized. All units have a multichannel architecture for functional control and single-channel structure for monitoring static parameters. The specific design and operating principles of Karat units and their components are described in detail. A general block diagram of one Karat unit is presented and its software characteristics are analyzed. DVK or IBM PC's are used as the control computer while the complex is programmed in an expanded FORTRAN language. The complex is executed as two functional control racks, an external terminal electronics unit, and a table. A prototype of the Karat-64 unit has been made; Karat-128 and Karat-256 units are expected to be developed in 1991-1992. Figures 1; tables 1.

### **Automated Test Generator for Incoming Integrated Circuit Control**

927K0011B Moscow *PRIBORY I SISTEMY*  
*UPRAVLENIYA* in Russian No 3, Mar 91 p 21

[Article by A. V. Dmitruk, Ye. M. Tikhomirova, O. I. Konopleva]

UDC 621.317.791:681.3.06

[Abstract] The problem of shortening the test routine development time for integrated circuits and relaxing the developer skill level requirements by automating the development process is addressed; as a result, a program-driven computer-aided test generating system (SAT) is developed

for checking IC's on the basis of an IZMIR instrument system linked to an SM-4 or SM 1420 computer (EVM). The system makes it possible to enter a test description in the dialog menu mode; the test program code is written in the Pascal-B language. The IC checking functions performed by the tests are described. The functioning of the SAT system requires a pretranslator from the Pascal-B language and translators from the Pascal-1 and Macroassembler language, a Rafos-2 operating system (OS), and a TX or TSX monitor. Test data can be produced in close-to 30 min while the test routine can be modified in 10-15 min. Prior to the SAT system, test routine development and debugging took about two man-months.

### **Superhigh-Speed Integrated Circuit Dynamic Performance Monitoring System**

927K0011C Moscow *PRIBORY I SISTEMY*  
*UPRAVLENIYA* in Russian No 3, Mar 91 pp 22-23

[Article by N. S. Zhilin, V. A. Maystrenko, A. V. Nikonov, K. R. Sayfutdinov, Omsk Polytechnic Institute]

UDC 621.316.72

[Abstract] Dynamic performance monitoring (DKF) of superhigh-speed IC's (SSIS) at upper clock frequency values is discussed and a block-diagram of a superhigh-speed integrated circuit dynamic performance monitoring system with a clock frequency of up to 1.024 GHz designed on the basis of phase-locking systems is described. The system's technical capabilities are evaluated and the outcome of practical developments is presented. The dynamic performance monitoring system consists of a phase-locking subsystem, a test sequence generator (GTP), a formatter, a test signal generator, and a test signal amplitude setter. The components and functioning of the above elements is described. The phase-lock loop's (FAPCh) mathematical model is a nonlinear high-order differential equation. A dynamic performance monitoring system prototype was realized using series 1500 and 6500 high-speed integrated circuits and the following parameters were attained: a clock frequency range of 100-1,024 MHz, a minimum pulse duration of 500 ps, a leading edge setting and trailing edge quantization step of 125 ps, a 0-10 ps range of test signal start position in the channel relative to the sync signal, and a time setting error of  $\leq 35$  ps. The results confirm the feasibility of using PLL methods in developing computer-aided monitoring (ASK) systems. Figures 3; references 4.

### **Termas-1 AMTs 07620 Automated Integrated Circuit Sorter With Heat Action**

927K0011D Moscow *PRIBORY I SISTEMY*  
*UPRAVLENIYA* in Russian No 3, Mar 91 pp 24-25

[Article by A. V. Zaytsev, V. K. Lyukshin, Instrumentation Science Research Institute, Penza]

UDC 62-50.007:621.382.82

[Abstract] The issue of incoming control of integrated circuits due to the increasingly stringent requirements imposed on the quality of instruments is addressed. A computer-aided Termas-1 AMTs 07620 integrated circuit sorter with a heat action developed at the Instrumentation Science Research Institute in Penza and intended for automating the incoming and production control of IC's encased in a dual in-line package (DIP) body with a 7.5 mm base is described. It operates in tandem with the Integral, Vakhta, Viking, AMTs 1134, and other static and dynamic performance monitoring systems. The sorter represents an automated thermal action unit which exposes IC's in a heat chamber to a given temperature during a given time, switches them for connecting test systems, and classifies IC's into three categories: "good", "reject", and "no contact". Details of the sorter design and operation are described and its principal specifications are cited. The sorter is expected to be upgraded in the future so as to raise the upper temperature condition bound, introduce below-zero temperatures to the thermal chamber conditions, sort IC's in wider and longer DIP bodies, sort IC's in other bodies and on satellites, as well as develop inexpensive sorters. Termas-1 sorters will be produced by the Severodonetsk Instrument-Making Plant. Figures 2; tables 1; references 4.

#### Development Trends in Today's Electronic and Computer Equipment Component Diagnostic Facilities

927K0011E Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 3, Mar 91 pp 26-27

[Article by N. P. Bayda, V. I. Mesyura, Vinnitsa Polytechnic Institute]

UDC 681.32

[Abstract] Known electronic device (EU) test diagnostics methods for electronic (REA) and computer (EVA) equipment are divided into three groups: general (structural), in-circuit, and combined. Today's state of in-circuit diagnostics (SPD) of electronic and computer equipment is briefly analyzed and the urgency of developing manufacturing defect analyzers (ADP) and various combined diagnostic facilities (SKD) is recognized. Relative advantages and shortcomings of many foreign and domestic in-circuit and combined diagnostic systems are compared and it is shown that unlike general diagnostic systems (SOD) which check the entire device, in-circuit diagnostic systems make it possible to simplify the test preparation procedure and locate the defects determined by the mutual effect of components. Principal development concepts of promising in-circuit diagnostic systems are outlined: to realize a modular bus design system making it possible flexibly to upgrade their memory and number of measurement channels; ensure the compatibility of various systems and methods, etc. References 8: 4 Russian, 4 Western.

#### Tester for Checking Printed Board Hole Metal Plating

927K0011F Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 3, Mar 91 pp 30-31

[Article by V. A. Markelov, G. V. Fedoseyeva, N. I. Davydov, Instrumentation Science Research Institute, Penza]

UDC 621.369

[Abstract] The increasingly stringent requirements being imposed on the reliability of printed boards (PP) due to the complexity and miniaturization of electronic equipment are discussed; it is noted that most contact failures in printed board (especially sandwich type) occur in the metal plating of through holes. This moves the quality control of through hole metal plating to the foreground. The equipment of printed boards is analyzed and a new device - the AMTs 07750 tester - with a built-in microprocessor for testing the metal plating of printed board through holes and its role in the printed board production cycle are described. Characteristic features of the tester and its advantages over other devices, e.g., the possibility of nondestructive testing, are summarized. The test results are accurate within  $1 \mu\Omega$  which corresponds to a thickness of up to  $0.01 \mu\text{m}$ . Data are entered into the tester from the keyboard on the front panel. Commercial production of the AMTs 07750 tester is planned for 1991. Figures 1; tables 1; references 2.

#### Ways of Improving Digital Device Diagnostics Confidence Level

927K0011G Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 3, Mar 91 pp 33-34

[Article by Ye. V. Mikheykina, Instrumentation Science Research Institute, Penza]

UDC 681.326.9.08

[Abstract] The issue of ensuring a high confidence level of digital device (DU) diagnostic results, primarily in the cases of locating faults in systems containing feedback loops, bus structures, bidirectional elements, and memory elements without initial setting circuits, is addressed. The reasons why the fault location procedure in digital devices containing the above components and the methods of intermittent fault location are so complicated are analyzed. The fault multiplication phenomenon is explained. The controlled probe method and its algorithm which involves three principal procedures - automatically locating and displaying the logical tester terminal and computing its standard response (program-driven), placing the tester probe at the check point (KT) at a given position (performed by the operator), and entering a certain set of input actions, computing the check point response, comparing it to a standard, and making the decision to continue or terminate the fault location procedure on the basis of this comparison - are described. The above algorithms were realized in the software of the KFK-3 static performance monitoring system for complex logic units. Figures 2; references 4.

**Procedure for Calculating Cable Line Reliability Indices**

927K0038A Moscow ELEKTROSVYAZ in Russian  
No 6, Jun 91 pp 17-19

[Article by T. M. Sakharova, A. P. Roy, V. F. Fedorchenko]

UDC 621.3.019.3:621.315.2

[Abstract] The history of reliability studies and methods of calculating the reliability index are briefly summarized and a procedure for computing the cable trunk communication lines developed by Kiev branch of the Communications Research Institute and adopted by the USSR Communication Ministry is analyzed. The procedure makes it possible to calculate the following reliability indices of operating and prospective lines: the failure density per 100 km of lines, the mean communication recovery time, the mean time between failures, and the availability factor or downtime ratio. Formulae for calculating these indices for operating cable lines are cited. It is indicated that if an analysis of the line reliability factor shows that the line does not meet established standards, the line design must be reevaluated. It is expedient to consider several versions while trying to attain the best reliability indices and minimize the cost, i.e., reach an optimum solution of the formulated problem. Tables 6; references 3.

UDC 391.6:535.8:666.189.2

**Fiber Optic Transmission Line Transceiver Modules in YeS-7920 Complex**

927K0038B Moscow ELEKTROSVYAZ in Russian  
No 6, Jun 91 pp 20-21

[Article by S. N. Popov, V. V. Shubin, Yu. I. Polovinkin, M. B. Moskaleva, Yu. S. Mukhin, V. P. Mamonov]

[Abstract] The development of public computer networks on the basis of fiber optic communication lines and their advantages over traditional cable line-based networks, e.g., noise immunity, range, reliability, and security, are addressed. A transceiver module (PPM) for a fiber optic transmission line (VOSP) operating together with data display devices which ensure a high data transmission confidence (at an error rate of  $10^{-9}$ ), increase the range to 2-4 km, and ensure information confidentiality and block unauthorized access are described. A block diagram of one fiber optic transmission line channel is presented and the operation of each of its elements is explained. It is shown that the calculated transceiver module parameters are consistent with the experimental measurement results. The dependence of the error rate on the signal/noise ratio on the photo-current amplifier (UFT) output is cited. A  $10^{-6}$ - $10^{-12}$  discrepancy between the calculated and experimental curves is attributed to the appearance of random errors caused by the power supply voltage instability and electromagnetic interference. The above transceiver

module design was implemented first as a prototype, then in commercial products; it has passed tests as part of a fiber optic transmission line combined with a YeS-7920 complex in a 2 km link lasting over two and a half years. Figures 7; tables 1; references 4.

**Mathematical Model of Coherent Optical Transmission Systems**

927K0038C Moscow ELEKTROSVYAZ in Russian  
No 6, Jun 91 pp 22-24

[Article by V. P. Voronenko, A. A. Vizel (deceased)]

UDC 621.391.63

[Abstract] Coherent optical transmission systems (KOSP) which make it possible to transmit digital signals over a great range without regeneration with a high frequency multiplexing density is addressed. A mathematical model of a coherent optical transmission system which makes it possible to calculate with a high accuracy both the optimal system parameters and the effect of the parameter spread on its characteristics is proposed and the difficulties of choosing a strict mathematical model of coherent optical transmission systems and, consequently, the complexity of the resulting analytical expressions are attributed to the laser's phase noise which generates noise on the decision circuit (RU) input whose probability distribution is substantially nonnormal. The assumptions used in developing the mathematical model are summarized and two types of coherent optical transmission system designs and their purposes are considered. The proposed mathematical model of a coherent optical transmission system ensures a high computation accuracy and makes it possible to determine optimal coherent optical transmission system parameters, thus reducing the time and outlays for its development. The proposed mathematical model may also be used as the basis for developing approximate procedures for calculating the characteristics of coherent optical transmission systems. Figures 2; references 11: 1 Russian, 10 Western.

**Radio Meteorological Parameters of Arctic Troposphere**

927K0038D Moscow ELEKTROSVYAZ in Russian  
No 6, Jun 91 pp 36-38

[Article by D. D. Darizhapov, G. S. Zhamsuyeva, N. B. Chimitdorzhiev]

UDC 621.371.3

[Abstract] The need to examine the signal fluctuation characteristics in different seasons in order to improve the performance stability of radio engineering systems and the shortcomings of known experimental studies of radio wave propagation in OTH paths, particularly in the Arctic basin where seasonal signal fluctuation characteristic variations were not taken into account, are

addressed. The urgency of accumulating and summarizing the radio meteorological parameters in the polar and Arctic troposphere is identified. To this end, statistical distributions of the atmosphere's refractive index and its vertical gradient at five Arctic stations - Kotelnny and Zhokhov islands, Shalaurov cape, and Cherskiy and Tiksi are cited. Archival data on aerological radio probing conducted over a three-year period three times a day (in January, April, July, and October) in the morning, evening, and night were used as the source material. Space-time characteristics of the Arctic atmosphere's radio meteorological parameters were analyzed by the response of three boundary atmosphere layers - 2-300, 2-900, and 300-900 m. The results of the analysis demonstrates that in the Arctic, winter months are the worst from the viewpoint of electronic equipment EMC (EMS) since the appearance of high-level UHF-VHF interference is likely in OTH paths. Space-time structure characteristics of the atmosphere's radio meteorological parameters may be useful for developing and designing Arctic communications networks. Figures 3; tables 2; references 4.

#### **Using Geographic Database in Automated Calculations of UHF-VHF Propagation Losses in Line-of-Sight Links**

927K0038E Moscow ELEKTROSVYAZ in Russian  
No 6, Jun 91 pp 38-40

[Article by V. I. Dmitriyev, Ye. M. Zaychik]

UDC 621.396.43

[Abstract] The procedures used in practical tasks of calculating the energy indicators of UHF-VHF radio communication lines based on statistical or empirical transmission channel models or diffraction formulae for computing the signal attenuation by obstacles falling within the radio wave propagation zone are discussed. A method of plotting the signal propagation path profile and thus determining the geometrical parameters of the signaling interval with the help of a geographic database is proposed. The accuracy of the damping factor calculation is estimated and the accuracy of the source data for calculating the damping factor is analyzed. In using the geographic database, the shadow map method was employed. In solving the problem of automated median UHF-VHF propagation loss value by means of geographic data on the terrain topography, it is expedient to use Micsa's procedure. The proposed computation techniques make it possible to justify the requirements imposed on these database parameters. The optimization of these procedures and the loss calculation algorithm helps to develop efficient software for real-time communication system design provided that the necessary calculation accuracy and speed are reached. Figures 3; references 5: 4 Russian, 1 Western.

#### **Bulk-Effect Microwave Integrated Circuit Analysis and Synthesis**

927K0038F Moscow ELEKTROSVYAZ in Russian  
No 6, Jun 91 pp 46-48

[Article by V.I. Gvozdev, G.A. Kuzayev]

UDC 621.396.6

[Abstract] Bulk-effect integrated circuits (OIS) which are often used in microwave (SVCh) devices and have minimal mass and overall dimension indices and maximum working frequency bands are addressed and the requirements imposed on CAD systems (SAPR) for implementing such structures are considered. The advantages and drawbacks of known heuristic methods of simulating bulk-effect IC devices are summarized and it is shown that a prospective CAD system should be based on the principles of electrodynamics and be maximally "user friendly" to bulk-effect integrated circuit designers. A topological diagram of the electromagnetic field and its elements and lines of force is examined and electrodynamic synthesis of microwave bulk-effect integrated circuits is analyzed. An approach employing the above topological diagram is demonstrated to be promising; in this case the computer-aided design system (SAPR) is free of the many constraints and shortcomings inherent in classic software systems and ensures an efficient designer-computer (EVM) dialog but calls for using high-speed computers with developed graphics dialog interfaces. Figures 3; references 2.

#### **Multiprogram Television Broadcasting Development Trends**

927K0026A Moscow ELEKTROSVYAZ in Russian  
No 5, May 91 pp 2-3

[Article by V. A. Shamshin, editor in chief]

UDC 654.197

[Abstract] The fifty years of television (TV) broadcasting experience in the USSR is summarized in order to select and justify its development trends allowing for the increasingly stringent requirements imposed by TV viewers on improving the quality and increasing the number of simultaneously broadcast programs. Frequency allocations constraints which set a limit to the number of programs broadcast simultaneously are discussed. Capital outlays in the TV broadcasting system are mentioned and the system is divided into the following categories in order to evaluate the possibilities of simultaneous nation-wide transmission of a larger number of programs: a TV program distribution network (SRPT); and local TV broadcasting networks bringing programs to users (VSTS). The conclusion is drawn that the TV system should be capable of ensuring the reception of at least five-10 programs simultaneously, including regional and local. Multiprogram TV network development trends in the worlds are outlined, particularly the development of cable distribution systems and satellite

direct TV broadcast systems. The prohibitive cost of TV signal receiver converters for this purpose is discussed. The need to find additional resources, primarily cable, for solving the problem is identified. References 1.

### **AXE-10 System in USSR Communications System**

927K0026B Moscow ELEKTROSVYAZ in Russian  
No 5, May 91 pp 6-8

[Article by Ivo Tikvica, Yugoslavia]

[Abstract] Cooperation between the USSR Telecommunications Ministry and Nikola Tesla plant which resulted in the development of the AXE-10 local and long distance automatic telephone exchanges is mentioned and a number of issues facing the experts from the USSR Telecommunications Ministry and Nikola Tesla plant is addressed. The switched telephone network in the USSR is discussed and it is mentioned that Nikola Tesla's AXE-10 system is capable of meeting the USSR telecommunication network development requirements by helping to build an ATX with an up to 200 thousand number capacity, ensuring the minimum length of expensive lines in the new ISDN network by using remote subscriber steps (RSS) and digital subscriber multiplexers (RSM), having the necessary functionally modular capability, and being controlled by powerful computers. Some designs ensuring the most economical EXE-10 implementation in the USSR communication network are described. It is emphasized that the experience accumulated by USSR communications enterprise experts and staff of the Nikola Tesla plant as well as their mutual trust will serve as the basis for developing an integrated expert group. It is hinted that under a license from Ericsson, Nikola Tesla could manufacture the necessary fixtures for making the AXE-10 system and other devices. Figures 2.

### **New MARS Stereo Broadcasting Equipment**

927K0026C Moscow ELEKTROSVYAZ in Russian  
No 5, May 91 pp 12-15

[Article by V. V. Korguzalov, I. N. Ostroukhov]

UDC 621.396.976.681.87

[Abstract] The predecessors of the MARS stereo broadcasting equipment which did not meet GOST requirements in a number of categories are summarized and the new MARS equipment intended for producing the multiplex stereo signal (KSS) with polarization modulation and controlling the multiplex stereo signal during the transmission is described. MARS system specifications are cited and compared to its predecessors - ARS-1 and ARS-2. The MARS equipment makeup and block-diagram are presented. The design of the stereo modulator unit (KSM) and operating control unit (KEK) as well as characteristic features of MARS components are described. With respect to its capabilities and electrical parameters, the MARS system

is superior to the ARS-1 and at least equal to the ARS-2 while meeting GOST requirements for fixed radio broadcast transmitters. The MARS equipment is designed for operating with an upgraded version of the Dozhd-2M FM radio station (UHF-VHF). The economic impact from its production (20 units a year) and operation is at least 125 thousand rubles. Figures 4; tables 2; references 5: 4 Russian, 1 Western.

### **Digital Subscriber Loop Interface Equipment**

927K0026D Moscow ELEKTROSVYAZ in Russian  
No 5, May 91 p 20

[Article by V. N. Yakovlev]

UDC 621.395.37

[Abstract] An HF digital subscriber loop interface unit (TsAVU) intended for time-division multiplexing of subscriber loops in urban telephone networks (GTS) by the pulse-code modulation method (IKM) and designed by the Sverdlovsk branch of the "TsKB" central design office scientific production association in cooperation with the Novosibirsk Telecommunications Institute imeni N.D. Psurtsev is described. The HF digital subscriber loop interface unit operates with Strowger, crossbar, and semielectronic exchanges. HF digital subscriber loop interface unit specifications are cited; its baseband signal transmission rate is 512 kbit/s while speech encoding rate by the PCM codec is 64 kbit/s. The HF digital subscriber loop interface unit component base includes PCM codecs and filters, master array chips, series K561 and K555 chips, and digital elements. Commercial production is expected to commence in 1992. Figures 3.

### **Automated Decameter Radio Communication Modems**

927K0026E Moscow ELEKTROSVYAZ in Russian  
No 5, May 91 pp 21-22

[Article by V. S. Girshov]

UDC 621.396.626

[Abstract] The development of modem technology and the interest in data transmission rates above the customary 50-200 bit/s which is important for, e.g., medium-speed data transmission systems operating at 600-1,200 bit/s are summarized. The development and extensive implementation of RF communications automation facilities as it related to the use of new modems is addressed and the possibility of improving modems for automating RF radio communications is considered. Multitone modems (MM) and monotone modems (OM) are described and compared and the factors explaining why monotone modems lag behind multitone modems are examined. In particular, the multipath propagation of RF signals is identified. It is shown that multitone modems should be used when it is necessary to transmit

data over RF channel at above 200 bit/s rates because there are no serial monotone modems; multitone modems are expedient for use in automated radio communications facilities, especially adaptive automated RF radio links. References 11: 8 Russian, 3 Western.

### New Optical Cables

917K0264A Moscow VESTNIK SVYAZI in Russian  
No 3, Mar 91 pp 31-33

[Article by A. S. Vorontsov, laboratory chief, and V. N. Spiridonov, section chief, Central Scientific Research Institute of Communications]

[Abstract] Specialists of the All-Union Scientific Research Institute of the Cable Industry and the Central Scientific Research Institute of Communications have developed new optical cables which are well protected against mechanical damage. A table gives the principal specifications for 7 different cables with an indication of the number of optical fibers and copper strands, external diameter, rated mass and mechanical characteristics. Each of these cables also is discussed in the text and the specific conditions for their use are indicated. For example, the principal purpose of the OKLS-01 and OKLS-03 cables, like the OKLK-03 and OKLB-01 variants, is for use in ground of any categories, including in ground where there is a high probability of cable damage by rodents, as well as in cable conduits of various types, on bridges and in shafts, in shallow swamps and under unnavigable rivers. They experience no losses due to increased electromagnetic influences. The OKLAK-01 cable, on the other hand, is suited for laying in frozen ground. The construction length of the cables must be not less than 2000 m (lengths of 1000 m are admissible on special order). The laying and assembly of these cables can be manual or mechanized at temperatures not below -10°C. The bending radius during laying and assembly must be not less than 250 mm. Cable transport and storage is in accordance with a number of State Standards.

### How to Save Precious Metals

917K0264B Moscow VESTNIK SVYAZI in Russian No 3, Mar 91 pp 36-37

[Article by V. S. Demenko, section chief, V. M. Yeskov, project master engineer, V. V. Gabelko, deputy section chief, and A. I. Roshchenya, head technologist, Planning and Design Office, Minsk Affiliate, USSR Ministry of Communications]

[Abstract] In order to find a way to conserve precious metal in the production of printed circuit boards an experiment was carried with a reduction in the palladium dichloride concentration in the previously used solution of matched activator (with a simultaneous decrease in the stannic chloride concentration). In the processing of printed circuit boards use was made of a matched solution of an activator of the following composition (in grams per liter); palladium

dichloride—0.1- 0.15; stannic dichloride—10-15; hydrochloric acid—100-120; sodium chloride—90-100. The procedures for preparing the solution are described in detail. If the activating capacity decreases the situation can be rectified by heating the solution at 70-75°C for two hours. The lifetime of the activator solution is eight months. There is a decrease in the activating capacity of the solution with an accumulation of copper ions more than 5 g/liter and with accumulation of iron ions more than 15 g/liter of solution. With accumulation of stannic chloride ions greater than 50 g/liter the solution is replaced. With a decrease in palladium dichloride concentration to 0.05 g/liter and maintenance of the stannic dichloride concentration the activating capacity of the solution does not change. A 50-liter tank is used in processing printed circuit boards (this procedure is briefly discussed). The improvements include: lesser expenditure of palladium salt, reduction in the quantity of contact-precipitated metallic palladium on the foil of the circuit board surface and high-quality adhesion of the precipitated coating. The described printed circuit board technology is now being introduced at branch plants. Figure 1.

### Georadar Sounding of River Crossings

917K0264C Moscow VESTNIK SVYAZI in Russian  
No 3, Mar 91 pp 40-41

[Article by A. V. Omelyanenko, head, Applied Radio Physics Laboratory, Institute of Mining in the North, Siberian Department, USSR Academy of Sciences, Ye. S. Netesov, master engineer, and V. V. Ber, master engineer, TPO-18 Service for Operating Cable Lines]

[Abstract] Divers and electromagnetic instruments have traditionally been used in annual checking of the depth of laying of cables beneath rivers, but such work is costly and of a low accuracy. A cheaper and more efficient alternative is the georadar sounding method for detecting the position and determining the parameters of laying of a cable line at the bottom of a fresh water body. The 17GRL-1 georadar is adequate for solving this problem in the range of water body depths to 20 m and with cable burial to 4 m. The computed error in determining cable position in depth does not exceed 0.1 m and in azimuth 0.5 m. The high accuracy in measuring water body depth is attributable to absence of dispersion of the real part of permittivity of ice and fresh water in the used frequency spectrum and the fact that velocities of wave propagation in the investigated media are known. The results of mathematical simulation were confirmed experimentally along the paths of cable lines crossing the Lena and Volga using a standard produced 17GRL-1 georadar sounder. Measurements made from the ice surface were checked by a diver. The accuracy with the new method was considerably better, although further improvement is required, such as a changeover to continuous sounding. The research clearly demonstrated that the method is quite effective in solving problems arising in the laying and operation of cable river crossings. Plans call for fabrication of an outfit of smaller size and weight with lesser power consumption than the

17GRL-1. It would simplify work, with registry of data for subsequent computer processing and with graphic display of results. Figure 1.

#### Measurements Using UDOL-17

917K0264D Moscow VESTNIK SVYAZI in Russian  
No 3, Mar 91 pp 42-43

[Article by V. P. Berdyugin, head of TPO-17 Production Laboratory, and N. N. Pavlov, class I engineer]

[Abstract] TPO-17 workers used the UDOL-17 outfit for determining the distance to the point of transient effects at unmanned amplification stations from the near end in the K-60P transmission system. Such measurements are

feasible for coaxial transmission systems operating at frequencies 0.37, 1.1, 4.4, 7.9 and 17.25 MHz. The outfit also can be rather simply adapted for use at other frequencies. The UDOL-17 is appropriately matched with the K-60P transmission system using special matching transformers. A block diagram with indication of the essential components illustrates the realization of measurements with the UDOL-17; the text explains the step-by-step sequence of operations involved in this process with repeated reference to the block diagram. Several highly successful applications of the UDOL-17 in detecting line irregularities are described. Although the UDOL-17 outfit is convenient in operation it has the deficiency that switchings in every case require removal of the instrument cover. Figure 1.